

AUTOMATIC DATA PROCESSING

JOURNAL OF MANAGEMENT AND INFORMATION SYSTEMS

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Also in this issue :

Counter information for retailers

Selling ADP in the 1960's

The programmer's task

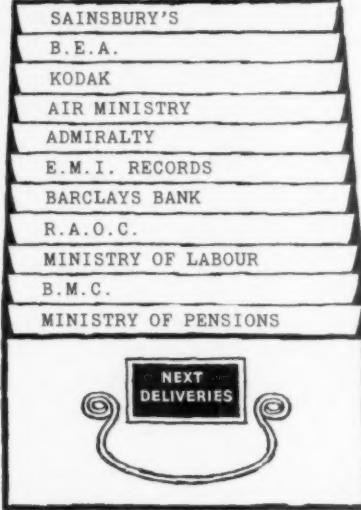
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AUTOMATIC DATA PROCESSING

JOURNAL OF MANAGEMENT AND INFORMATION SYSTEMS

VOL 3 No 2
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AUTOMATIC DATA PROCESSING

is published monthly by Business Publications Ltd.

Advertisement, editorial and sales offices : *Mercury House, 109-119 Waterloo Road, London, S.E.1.* (Waterloo 3388.)

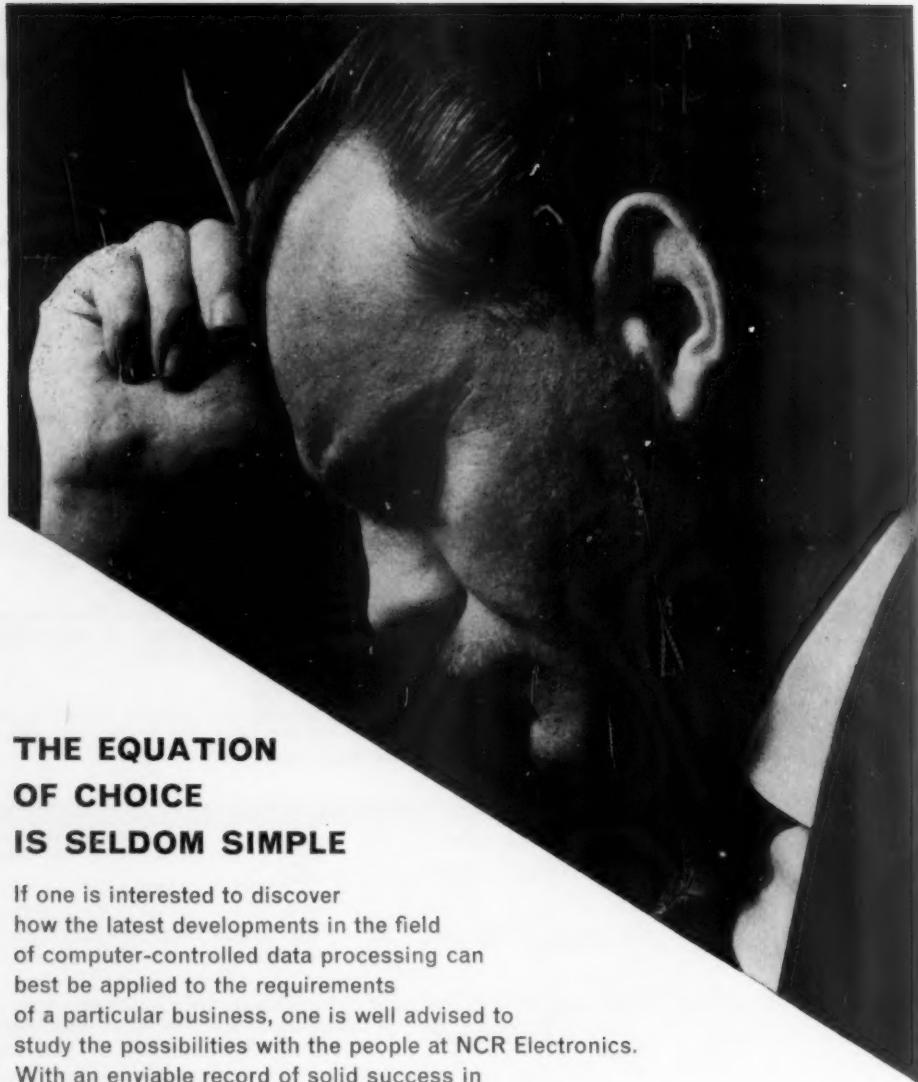
Change of subscriber's address : Please notify publishers six weeks before change of address is to take effect, giving present address in full and new address.

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Editor Philip Merchant; Assistant Editor David Roach-Pierson; Art Editor Douglas Long; Advisory Editors John Diebold MBA, A S Wainman; Editorial Director George Copeman PhD; Advertisement Manager D G A Shallcross; Sales Director J Hinchcliff.

Price for 12 issues post paid:
United Kingdom and Eire 45s.
USA \$6.50
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Not Cold After All

THESE are several reasons why, having decided to publish during 1961 several series of articles on the data processing problems found in distinct industries, we opted to lead off with a review of the insurance industry [the first two articles begin at page 16]. It has, of course, a creditable total of computers installed or on order—about 15 at the last count—but, more important, it is a paperwork industry for, as with the banks and finance houses, the end products of the insurance industry are documents, and no matter how skilful a life insurance company, for example, may be in standardising them, or minimising their number, if it sells a large number of policies it will always have to prepare an even larger number of documents. Unlike companies in other industries, who can, if they are sufficiently imaginative or inventive, expect from the introduction of computers new applications and benefits—the so-called ‘intangible’ benefits—an insurance company will have few jobs to put onto a machine that could previously never have been tackled and for which existing methods would have been totally inadequate. There are in the insurance business no problems equivalent to, for example, transport and route scheduling problems to which natty linear programming techniques can be applied.

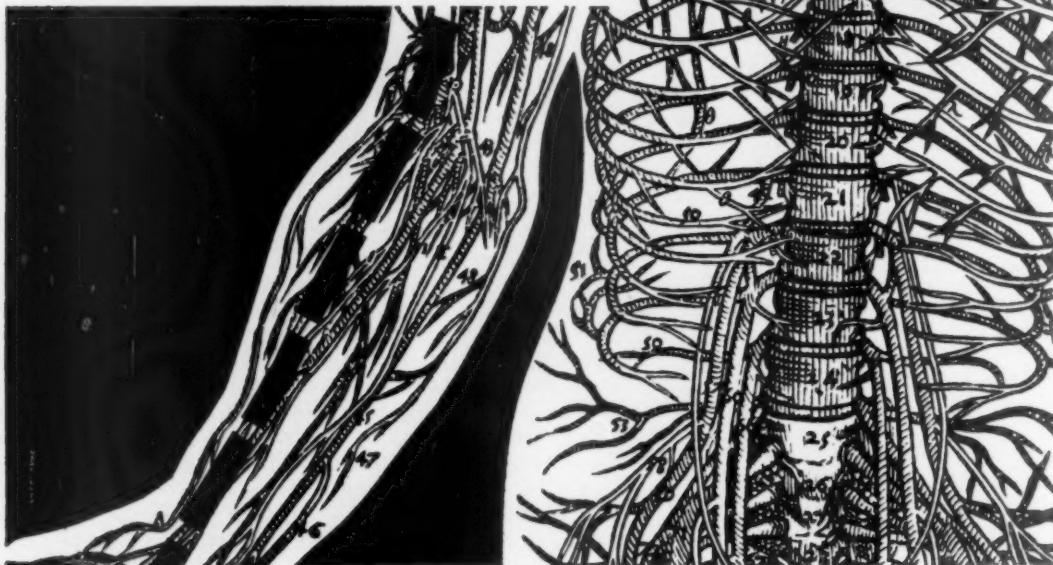
This means that the justification for introducing automatic data processing into an insurance office must usually hang on expected lower costs. A straight comparison between the old and the proposed method has to show that the proposed method will give lower running costs. If this reasoning is correct there are a few conclusions to make: for instance, if a dozen insurance companies can see their way to lower operating costs by putting policy work onto computer, then the whole industry (with the possible exception of one or two ‘very efficient’ small companies) ought to be able to as well. The argument of volume—‘it only becomes economical to acquire a computer when you have so many hundred thousand policies’—may hold good in some instances, but then acquiring a computer is not necessary: time may be hired at a computer centre or a machine can be shared through a joint purchase arrangement. Another conclusion is that businesses with problems and tasks similar to those found in the average insurance office ought to be able to justify automatic data processing—for example, the building societies: they, superficially at least, share many features with insurance companies, and they are not the only ones who can profit from the lead of the insurance companies who have jumped in the pool and found the water wasn’t cold after all.

* * *

This month’s article from John Diebold and Associates [see page 22] casts a forlorn look at the American retail industry’s caution in applying automatic methods to its data handling and accounting problems. In a nutshell, few American retailers have shown much interest in point-of-sales recording equipment because this usually has to link up with computer or punched card installations, because of the cost, and because of ‘resistance to change.’ These reasons probably influence British retailers who show little interest in automation. One factor may change this however—the growth of credit purchasing. At the end of last year one London department store claimed it was opening new credit accounts at the rate of 100 a day, and Burton’s the tailors had to instal a computer just to keep track of their credit accounts. If this trend continues, it looks as if simplified point-of-sales recorders might first make their entry for credit business.

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AUTOMATIC DATA PROCESSING

DATA DIGEST



Thin-film computer

Shares go up in anticipation

The first commercial computer to make use of the revolutionary thin-film memory storage was announced in the USA recently. This is the Remington Rand 1107 computer. A forerunner of the 'third generation' of computers, it caused a stir in the American business world, and shares of the parent company, Sperry Rand, went up 20 percent on Wall Street.

The 1107 is described as a modular solid state system, with adding speed of 0.8 microseconds; its multiplying and transfer speeds are 7.4 and 4 microseconds respectively. It operates in parallel and accepts data through up to 16 input and output channels. It is fully compatible with most input, output and storage equipments, and is able to use COBOL, AIGOL, and FORTRAN routines.

The thin-film memory serves as a control memory; the internal storage of characters is in dual magnetic core units. The capacity of this main store is between 16,000 and 65,500 words; the thin-film memory has a capacity of 128 36-bit words, and read-write cycle time of 0.6 microseconds.

Remington intend the computer for commercial scientific and military usage, with the emphasis on the scientific. The 1107 is the first

commercial computer using thin-film memory, though in the USA Honeywell have prepared the 'hardware' for an airborne computer using thin-film techniques.

In Britain ICT are known to be developing thin-film storage systems, and one report states the company may have found a way to manufacture these in bulk economically.

For the smaller firm

New low-price card equipment

'If you are a manufacturer with a payroll of 100,' said Mr Cramond of IBM, 'the 3000 accounting system would be economical for you. If you are a commercial user with a staff of 25 or less, the system could serve you.' Mr Cramond was introducing IBM's latest low-cost system—a punched card equipment, the 3000 series, which comprises four basic machines; a punch-verifier; an electronic sorter; a combined printing and gang and summary punching accounting machine and an interpreter. IBM have had this equipment under their coats for some months now while they carried out feasibility studies in local government, breweries and banks

in order to tailor the machine to the appropriate business application.

The system—on show at IBM's new premises at Newman Street, London—was first shown at the Hanover Fair in May last year and already over 1,000 orders for the system have been received in Europe. A complete system costs about £7,000 bought outright or can be rented at £1,700 per year. A staff of two could operate a basic installation.

A full detailed report of this equipment will be carried in next month's **AUTOMATIC DATA PROCESSING**.

The gamesmen

Computer plays computer

The bandit-cowboy lurched to his feet to face the sheriff. 'Goldarn it,' he said thickly, 'that no-good computer's programmed me one whisky too many!' And so another TV lawbreaker bit the dust. This is not fanciful; a computer at the Massachusetts Institute of Technology has been programmed to write two-minute TV Western-type scripts. And the programmers of MIT have built into the program an inebriation factor, so that the computer can adjust the behaviour of the bad man to the amount of alcohol he drinks.

This is one of the ways that computer manufacturers are trying to 'teach' their computer to program themselves, to stimulate in computers the associations that the human brain forms while learning. Other methods include 'teaching' two computers to play draughts; one is fed with the 38 principles and rules of the game; the other is provided, move by move, with some of the best draughts games recorded. It will then be interesting to see who will win, the computer acting on experience of the basic principles, or the computer which analyses the moves and refers back to its memory. From this experience it is hoped to be able to program a computer to deal

in concepts rather than in word categories, for use in language translation and information retrieval. Other games include word associations, by which several theories of word associations are tested. Some 50,000 words are fed into a computer so that eventually the computer will associate words, e.g. blue with sky, etc, and so be able to store data in several different forms. Another method has been to make the computer memorise syllables, so that when a certain syllable is called the computer responds with the syllable that should follow. It is reckoned that making computers play these games and others, like chess and bridge, or compose music, takes up annually between £100,000 and £600,000 worth of machine time in the USA. Though much of this is designed to impress prospective customers the computer gamesmen think that they may be able to achieve a breakthrough in self-programming by the computer, which will simplify and cheapen the operation of the computer, and avoid many of the human errors which arise from errors in programming. Some of these games produce surprising results—a line of columnist's gossip: 'The Duchess of X will not marry dustman! We are just good friends, she says' once appeared in the middle of an IBM payroll.

Times for buses

London Transport compute

London Transport are using an Emidec 1100 to program and produce route schedules, related statistical information, vehicle time cards, and inspectors' time books.

At present only simple timetable scheduling has been done, a route from point A to point B, without any turning points or branches. The program logic is worked out and the timetable compiled only once, since variations for different routes can be accepted by the program. The timetable is compiled in 10 seconds (as opposed to an hour by conventional methods)

The Thin-film Memory

American computer companies are putting considerable research effort into the development of thin-film memories. This could open the way for the production of a third generation of computers. These machines, it can safely be predicted, would be smaller and cheaper computers with greater capacity than present ones and more economical of power.

Thin-film memories are formed by depositing a ferro-magnetic metal vapour on a thin glass substrate. This forms a metal dot, some 40 nano-inches thick, which thus becomes the unit of magnetisation. This dot can be 'switched' in a nano-second (i.e. a billionth of a second) thus making storage and retrieval possible at a speed directly related to this figure. Thus it would seem that speed for storing and retrieval information on thin-film might be increased by something like a thousand times compared with present memory systems.

It is likely that much more research on miniaturisation of components will be needed before the third generation of computers will be able to function exclusively with thin-film memories. At present the first thin-film computers—the Univac 1107 is referred to on page 5—use the new memory device to supplement core storage and as a control store.



WILL IT RING THE BELL?
Bus boffins confer

and the various related forms printed out. The saving on time on this printing is very considerable, the more so as there can be no errors in transcription.

The next stage of computer programming must be the compiling of the schedule for complex timetables, with intermediate turning points, two or more garage allocations and inter-working requirements for two or more routes covering the same journey path. Here the computer's superiority over the manual method will be even more marked.

This is the first time that a computer has been used for route scheduling, and timetable compilation. London Transport hope that it will be able to work out time-

tables which will correspond closely to the fluctuating day-to-day needs, and also deal with periodic overload conditions such as at the FA Cup Tie and during the Wimbledon Tournament week.

First in at Putney

1301's debut at computer centre

By the end of the month ICT hope to have their first 1301 computer (described in the June, 1960, issue of ADP) off the assembly line and on view in their Putney Bridge computer centre. Since the 1301 was first announced in May, 1960, there have been no less than 40 orders 'off the drawing board,' including installations for Rubery Owen and Co, British Railways, the Institute of London Underwriters, and the South West Regional Hospital Board.

Stakhanovite 803

British computer in Russia

Following its debut at the British Scientific Instrument Manufacturers Exhibition in Moscow, the National-Elliott 803 bought off the stand by the Russian authorities, is now working a two-shift timetable



ONE FOR RUSSIA AND ONE FOR THE ROAD
Left: The 803 in Moscow. Right: The Leo at Standard-Triumph

in the Russian Central Institute of Complex Automation.

The Russian 803 is a standard machine with both punched paper tape and card inputs and paper tape output, and a magnetic core store of 4,096 words. It is being used regularly in the solution of day-to-day problems in the Institute.

Sign with figures

'Numerical signatures' filed away

By converting names, occupations, addresses, dates of birth, etc, into a 15-character 'numerical signature,' you can have a single master file of all your personnel, say IBM. This can be done by means of a new program code, Autopic, which is operable at present on the 650 computer, but is to be made available for all IBM computers.

The 15-character numerical signature, into which the personal details are automatically converted by the program, breaks down into two sections. The man's name takes up the first 10 characters, which comprise a combination of the component letters of the name. The next five characters are devoted to his personal details, appropriately coded. The initial character of each signature is a letter, and the remainder code numbers. In this way an alphabetical sequence is maintained. Provision is made in the program for distinguishing identical names and personal data, etc, so that they can be recognised and recorded.

It is hoped by this method that the maintaining of separate

files by different classifications can be dispensed with, thereby saving a great deal of space, time, as well as eliminating a possible source of manual error.

Movies and strips

Spelling it out on the screen?

'Say it with movies' seems to have become one plank in the ICT sales platform: first there was a colour film *Time to Think* and now the company have followed this up with a second colour film *Satisfied Users* which takes the viewer on a tour of ICT computer installations: an interviewer asks questions about the uses to which the various computers are put, gets his answers, and moves on. A lot of ground is covered (and a lot of industrial scenery filmed) but beyond being told that the computer *helps* Morgan Crucible, Brighton Corporation and a host of others, little emerges. More of a pat-on-the-back-for-us film, it adds little to the sum of knowledge.

Very determined to start others off with a small capital of knowledge, on the other hand, is a series of film strips-cum-narrative prepared by the Institute of Office Management. So far three strips have been made: the first explains what is electronic data processing and the next two explain how a computer actually works. Carefully thought out, these strips run for 18, 35 and 33 minutes respectively, provide a bit-at-a-time explanation, but are probably best used in short bursts, with a lecturer providing additional information for sustained instruction via a

screened photograph and a relentless recorded voice can be a little soporific. Copies of the strips and the record that accompanies them may be purchased from the Institute of Office Management.

Two go in

For motors and groceries

Two major installations have recently gone into service—a Leo IIC at the Canley works of Standard-Triumph International, and an IBM 305 Ramac at the central warehouse of Joseph Burton and Co, the Nottingham grocers.

Main purpose of the £180,000 Leo installation is to oversee the stock control of the 14,000 different components used in the production of Standard-Triumph cars. The computer will calculate the parts likely to be used on each production shift some 24 hours before, and automatically re-order components; it will also produce daily stock availability records, and do job costing.

The Joseph Burton Ramac will also be used for stock control. One of the more interesting features of the computer is that facilities are given for direct interrogation of the computer at any of four remote stations, thus allowing for subsidiary warehouses or even the major stores themselves to be able to have access to the computer memory. It is thought that one of these remote stations, which will also be equipped with an output printer, will be wholly at the service of all the branches, who will telephone in their enquiries.

continued on page 9



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What do these men have to offer?

Jack Crownshaw, Mike Stammers and Harry Johnson are computer salesmen, offering equipment for tens of thousands of pounds, but what do *they* think of their products? What benefits do they believe they hold out for you? Robert Spark provides answers to these questions in a series of profiles which begin on page 29.

No good looks? Are your designs honourable?

British computer manufacturers are rapped over the knuckles by a recent issue of 'Design,' the monthly magazine of the Council of Industrial Design. British computers, claims the magazine, have a drab appearance as compared to their more streamlined American counterparts. Allowing that British manufacturers are in a state of flux, and have special problems in that they have to use standard components individually designed, they are urged to use 'a more imaginative approach to appearance' based on their existing ergonomic principles. The ICT 1301 is allowed to be breaking ground in this direction.

Signalled out for praise are the Ramac 305, which provides a visually integrated environment and makes the most of 'the aesthetic character of its disc storage unit.'

BOOKS REVIEWED

EDP Idea Finder. Edited by Richard Canning, Roger Sisson and Margaret Milligan. Pp. 656. Canning, Sissons and Associates, Los Angeles, California (1960). Price \$69.00.

In the USA the rapidly snowballing interest in automatic data processing during the last five years has produced in turn a phenomenal output of articles and books on various aspects of the subject. One of the more useful American publications of those which reach me each month—which helps solve this problem of output—is the *Data Processing Digest*, which 'de-guts' on average some 30 articles and presents in digested form the 'meat' they contain. The editors of the Digest are voracious readers and cast their net widely in the magazine pond, so that the Digest caters for catholicity of interests within the data processing field, and gives a quick idea of what is happening and who thinks what in the USA.

The Digest's editors have now hit on the idea of bringing out an omnibus edition which covers the years 1957 to 1959, but in hindsight have brought order in what, over the months, has been

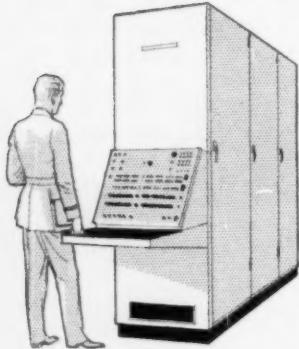
a heterogeneous collection of digested articles. Thus the EDP Idea Finder is very much what its name implies—the book is divided in broad categories of information, setting out chronologically the articles that have appeared on specific subjects—EDP and management, system design, sociological aspects, equipment, operational research, applications. These broad categories are further subdivided into specific subjects which develop a theme. Particularly useful is the section on applications where digested articles on an industry—such as insurance—or on one procedure—such as purchasing—are collected together. This brings to the analyst or systems designer with specific problems the opportunity to discover quickly what work—if any—has been published on the subject.

How much is a good idea worth? This is a pertinent question to ask when considering this book: it certainly contains a fund of experience which will recommend it to many people, which will be a point to remember when paying the invoice for it—it costs in sterling £26 post paid.

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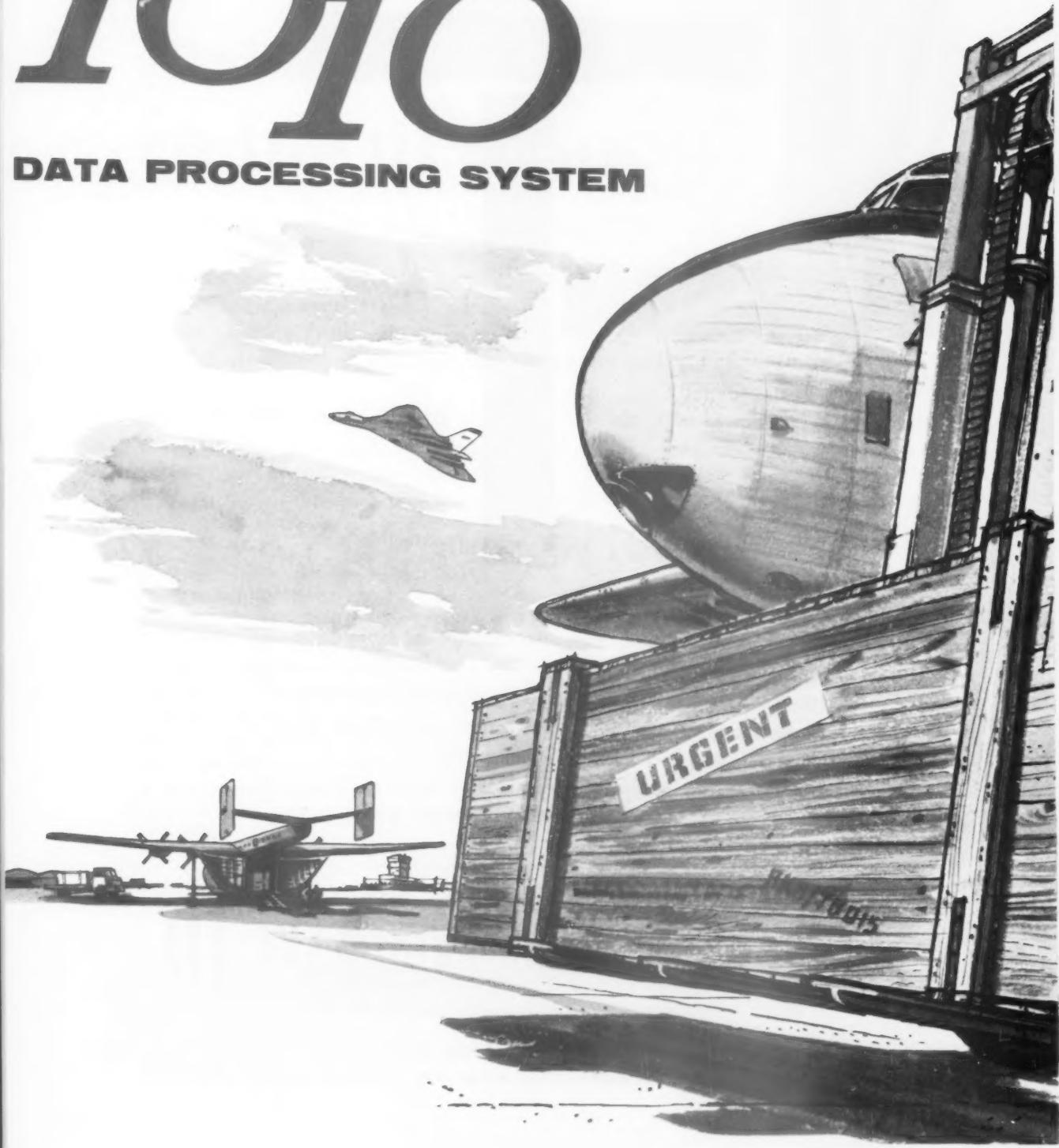
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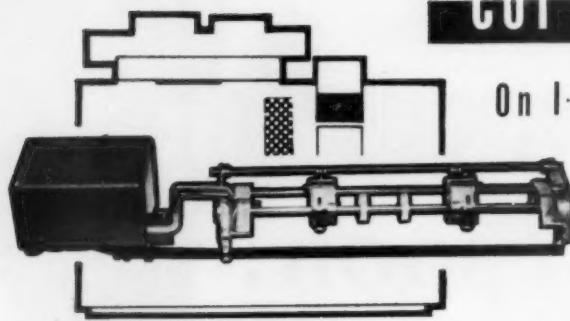
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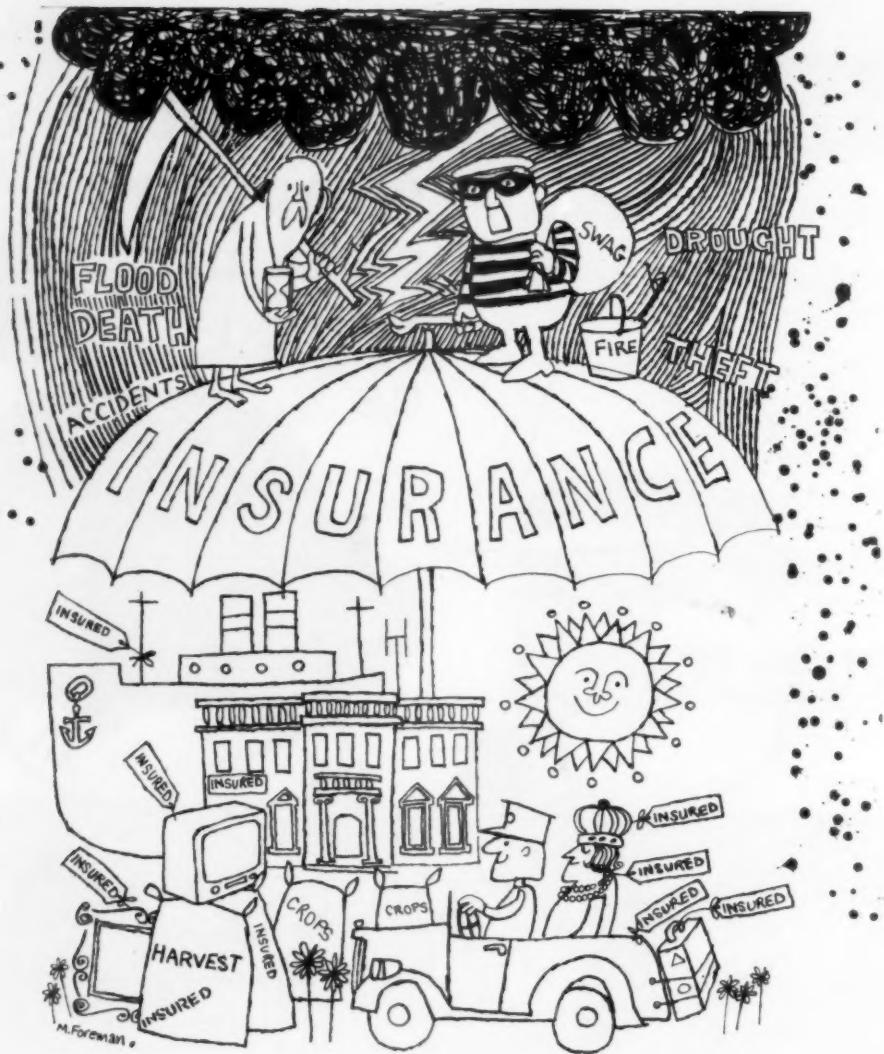
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ADP is on the agenda in the
INSURANCE
INDUSTRY

Last year a large batch of the orders for computers came from insurance companies, and already a small number of insurance offices are making use of machines. Clearly, a large section of the industry has caught a whiff of the possibilities of automatic data processing, and during the past few weeks our correspondent, Keith Bean, has been interviewing executives of insurance companies to tap their experience and to learn of their plans. The result of his researches is a series of articles, the first two of which are published below, while others will appear in succeeding issues. These articles throw into sharp relief the industry's vast paper handling task, and examine the modern solutions contemplated.

THE end product of the insurance industry is security—usually in the form of a consoling and tidy nest-egg if tragedy befalls an individual, his family or his business—but physically it is documents. In this, though the manner and matter of their business are almost infinitely varied, the insurance offices are specialists. Their objective, paradoxically, is to cut production, not expand it—to streamline each document and to minimise the number of documents associated with each contract.

Broadly, the main activities of insurance business can be conveniently pigeon-holed into six categories:

1. Life, which subdivides into group life and pension schemes, as well as ordinary life policies and the penny-a-week sort of thing which the insurance offices call industrial business.
2. Fire.
3. Sickness and accident.
4. Motor.
5. Marine.
6. Re-insurance.

There is evidence that all sections of the industry are becoming increasingly aware of the need for constant modernisation of methods, though as in other fields some insurance companies are obvious 'laggards.' Before the war the industry's needs stimulated many of the inventive developments which have long become commonplaces of office mechanisation generally. Yet

some of the companies that pioneered in the early days, remain resistant, by reason of conviction or merely through over-caution, to the latest developments in data processing.

In the very early days of punched cards, the insurance companies were the first organisations to exploit the punched card on commercial, as opposed to purely statistical, applications. As early as 1913 the Prudential ordered seven tabulators, seven sorters and 50 punches to establish the biggest punched card installation in the world. When Powers designed his punched card tabulator with its alphabetical printer in 1920 it was quickly adopted by the Norwich Union, Pearl, Liverpool Victoria, Wesleyan and General, Britannic, Royal London, and Refuge as well as Prudential.

Over the years additional machines were brought out to meet insurance needs—the reproducing punch was an example—and the same applied to attachments and to the packing of more and more columns of information onto the punched cards. Many of the older and smaller machines continue in active life, useful supplements to larger machines, particularly in the field of statistics.

The urgent demand for new machines, and the eagerness of insurance companies to adopt them created pitfalls, however.

With equipment of limited capacity a piecemeal approach was inevitable, sectional routines being tackled with the most suitable machinery available at the time. Within a few years most insurance

companies had a punched card installation for statistics, another for the circulation of life policy reserves, an addressing machine (with stencils or plates) for renewals, the keyboard machines for accounts—plus, of course, a vast amount of pen-and-ink work.

Despite promising developments in the thirties progress toward an integrated approach to insurance data processing was checked in 1939 and replacement equipment immediately after the war largely followed the pre-war pattern. The piece-meal tackling of the problem was entrenched.

The diversity of equipment remains today—a weighty drag on comprehensive reorganisation. Records remain in being for the duration of the policy and the task of converting from a multiplicity of storage methods to a more practical system is formidable to contemplate.

The example of the Prudential serves to illustrate this. The Prudential has ordered an Orion computer, but in order to be able to use it it has had to solve the problem of converting a portfolio of one and a quarter million ordinary life policies from hand-written, typed, printed, address plate and punched card records in seven different orders to a consolidated magnetic tape file.

Records to be converted comprise:

- 1—Proposal papers in policy-number order;
- 2—Policy registers, some bound and some loose-leaf, of older policies (about half the policies in force) in policy number order;
- 3—Policy record cards of younger policies (the other half) prepared on Adrema plates and filed in terminal digit order;
- 4—Addressograph plates for the old policies filed in renewal order, viz—(a) geographical area, (b) frequency of premium payments, (c) month of first renewal in calendar year, (d) local district and (e) policy number;
- 5—Adrema plates for the younger policies—main plates in renewal order and one or more ancillary plates for some policies in terminal digit order (but not the same as in 3 above);
- 6—Policy loan registers supplemented by Addressograph plates filed according to month of loan grant and, secondly, calendar date of loan;
- 7—A file of punched cards (45-column, with round holes, now obsolete) in renewal order, used for printing lists of premiums due; and
- 8—A file of similar punched cards in valuation order, used for annual valuation.

Only two of the records are in 'machinable' form—the last two punched card files—but no machinery exists capable of tabulating all the data on the cards in intelligible form.

The Prudential faced the fact that while these cards could possibly be reproduced on modern cards acceptable to an electronic system the information in the other records would have to be fed in by first punching into cards or paper tape.

The conversion, with a large measure of editing, would take 300 man-years, they estimated. How they tackled the problem will be discussed in a

later article but the size and complexity of it becomes quickly apparent.

Further, the organisational change-over must be effected without disruption of current operations. And, of course, this conversion will not embrace all the company's business—group pensions (1,400 schemes covering 250,000 lives), industrial life branch (30 million policies) or general business (something over 3½ million policies) will be left untouched.

There is no doubt that the industry is moving toward the automatic insurance office. The most progressive offices have been closely studying the potentialities of electronics for a decade, through the development of calculators and then computers.

Costs are still high and each office must make its own assessment of the picture. And it would be folly to leave out of the calculations the amortisation of the outlay represented by preliminary and feasibility studies, the months of detailed work on planning, the initial programming and staff training as well as the conversion operation.

The British offices are aware of these considerations, but this has not deterred some 15 companies from ordering computers. A trend in the post-war insurance world, which has encouraged the use of computers, is the process of merging and amalgamation among companies, creating larger units and hence the need and scope for advanced data processing equipment.

For many businesses the computer is the only way of solving problems—of stock movements, production control and so on—which hitherto could only be tackled by rule of thumb, if at all. In the insurance business the sort of problem which could not be solved by existing methods rarely arises and the economics of electronics are therefore the more important.

At first sight the costs of introducing electronic data processing seem largely independent of the size of the firm—purchase or hire of the machine, programming and the organisational change-over.

However, the costs, for the smaller office, can be greatly cut either by the use of computer bureaux or by shared purchase and operation of machines by two or more offices. Two companies, the Scottish Widows and the Standard Life, have already opted for the joint purchase of a Pegasus machine for their group pensions work.

Such methods will be examined later but it can be said here that they do not involve a basically different approach to that of buying a machine outright. The experiences and studies discussed in these articles are, in other words, pertinent to any consideration of moves into automatic data processing.

ADP and the insurance business—1

Pioneering Experience

IN British insurance practice, group life and pensions schemes, which involve an enormous amount of calculation, present an obvious field for computer application. It was for this work Legal and General acquired the first computer to go into a British insurance office and it is the basis of much of the insurance work done at computer service bureaux, notably at the Leo centres.

The Legal and General provide some object lessons, which, even after allowing that theirs was an early first generation computer, remain pertinent. They begin right at the start when Legal and General, having considered buying a computer for a year or two, ordered in June, 1957, a National Elliott 405.

At that time the company was planning its new building at Kingswood in Surrey so that special provision could be made for the computer. Even so, there were snags. They might be less severe today but many of them could still cause trouble. Transistors have reduced bulk, weight and heat dissipation problems, for instance, but the improvements sometimes tend to be exaggerated, and anyhow line printers and other peripheral equipment remain bulky.

Floor space for the 405 was strengthened to take 150 pounds weight to the square foot instead of the normal 60 pounds. The computer room was given solid walls, fire-resistant doors and a fireproof-waterproof ceiling.

Heat dissipation, a problem which may largely disappear with future machines, caused a shock. It was found that the computer required 25 percent of the forced ventilation capacity installed for a building housing 800 staff. Short of major architectural alterations the only answer was full air temperature control by an external cooling plant. A 12-ton plant—plus special window glass and venetian blinds to beat the sun—maintains computer room temperature at 70 degrees F.

Also, in view of the close tolerances to which much of the mechanical equipment is manufactured, it must not get too cold, even overnight. So the temperature control has to bring in more

heat when it gets cold, first through the building's normal hot-water radiators and then through a battery of electrical heating elements.

The 405 was delivered at the end of October, 1958, but was not handed over until April, 1959.

The company did some work on the 405 before it was handed over and had partly tested programs on other machines. As a result the first production program, for the payroll, went on the machine immediately.

Legal and General chose this application because it was comparatively simple. The program produces pay slips, traders' credit slips for the bank, a list for each branch of employees paid in cash, details for widows' and orphans' pension fund and superannuation fund, quarterly returns in respect of National Insurance deductions for employees and employer. It also provides annual returns to the Inland Revenue on forms agreed with the Revenue in lieu of the normal tax deduction cards.

But the main job was the large group life and pensions business.

The essence of the typical contract in such schemes is that an employee will receive for each year of service a specified amount of pension, the amount accruing each year being determined by his earnings. Also the employee's life is assured, commonly for a sum between one and five years' earnings. The employer usually contributes to the cost of pension, the employee paying the balance plus the whole cost of life assurance.

Under the single premium method of costing it is necessary to re-establish at each policy anniversary the premium to be charged for the ensuing year. Since at lower ages an employee's contribution may exceed total cost of pension entitlement for the year, the retained excess delays the date when the employer must contribute to make up later deficiencies, and thus it is necessary to establish for each employee at entry—and to re-establish at each change—a date on which employer's contribution will begin. Also many employers purchase pension in respect of past service by employees in service at the commence-

ment of a group scheme and this is usually done by payments spread over 11 years or more.

In addition there are varying provisions for return of employees' and employers' contributions, and so on. A further complication is added by changes in interest rates and, with them, premium rates so that in time several different rates of premium may be in force in a particular scheme, often even for different strata of benefit for a particular employee.

Even in such a necessarily sketchy statement of it, the size of the job and something of its shape are apparent.

'Apart from flexibility, speed and reliability, the overriding requirement of a computer was a large backing store to accommodate all valuation and costing factors and, at the time of ordering, this requirement was paramount in determining the particular machine,' says Mr R G Jecks of Legal and General.

'Whereas with magnetic tape (or film) machines it was feasible to read a whole file to deal with alterations affecting a small percentage of members—thus making the whole job fully automatic—if a punched card machine were used a considerable amount of hand-picking and filing would be required since selective mechanical extraction would be too slow. This manual intervention might introduce too many errors.'

WHAT THE COMPUTER COMPRISES

Legal and General's 405 has a working store of 512 words, each of 32 binary digits including sign digit. These words are stored in 16-word magnetostrictive nickel delay lines and there are three immediate access registers in single-word lines. This working store is backed by a 16,384-word magnetic disc, to and from which information may be transferred in blocks of 64 words. Input and output of standing files is by six magnetic film units arranged to permit continuous reading and writing.

Primary input is by paper tape punched and verified on standard Creed machines. Tape was preferred to cards in view of added flexibility, particularly as item length is virtually unlimited.

For printed output there are three methods. An electric typewriter (up to 20 characters a second) prints out exception reports and operational notes to the operator and is also useful in program testing since results are immediately visible.

Secondly, a directly connected paper tape punch (about 25 characters a second) is used for summary items for off-line printing, especially where further copies may be required later or where short items of output may need to be fed later into the computer.

Bulk output is recorded on magnetic film, physically identical with the storage film but containing information in coded alphanumeric characters instead of in true binary form. When a film is full it is removed from the main computer and its information then is transferred to paper tape. Since the film may be written on four tracks in each direction, four paper tape punches may be driven at once. The paper tapes are then used to drive a battery of Flexowriters.

INTEGRATION IS COMPLEX

Legal and General intend the computerisation of its group life and pension business to be a fully integrated system, starting with the maintenance of records for the employees of companies for whom it runs the funds. It intended to produce accounts to policy holders for premiums received, for payments out in respect of surrender values and return of contributions, and so on, calculation of reserves and other statistical data.

It became clear early on, however, that the completion of this task, quite a complex one, would take longer than expected. Legal and General is by no means unique in this experience. In practice it was not until the end of last year (1960) that the company reaped the first fruits of the program. The conversion procedure will, of course, be a lengthy one, probably two to three years.

One of the big problems was that the computer had to calculate by reference to historical data a large amount of accumulative information for each individual—such things as total contribution to date, pension earned to date, current surrender value if he left his employer, and so on. And all this had to be obtained before the computer could calculate and produce current accounts for the future; no start could be made until the computer was ready to act on the information so provided.

So Legal and General considered other jobs to put on the computer to gain experience while working on the bigger job—jobs which required less programming and which ultimately would not take up too much machine time, since the group business would finally occupy at least a full shift. The payroll was the first and the payment of dividends to the company's shareholders the second of such small jobs. The dividend program, in operation well within a year, provides counterfoils and warrants and produces a list of dividends paid against which cleared warrants are checked and the annual returns for the Board of Trade.

The company has now written a program for commission payments to its agents on ordinary life policies—much simpler than the group pro-

gram but dealing with a far greater volume of data than the other two small jobs.

In addition a few mathematical jobs—the preparation of premium rates and annuity rates, for example—are done on the computer, all of them, of course, much less complex than even the simplest data processing operations.

In the main computer task, the group schemes, the latest improvements in tape speeds, permitting perusal daily of the entire file even with a large business, make some of the practices adopted at Legal and General not strictly necessary but these are matters of procedural detail rather than principle.

Their system works on an alterations selection run, a billing run and various accounting runs. The billing run is the heart of the system. It examines the master record film, updates it by reference to sorted alterations and writes the amended particulars on the new master record film and at the same time it performs all calculations necessary to produce the completed accounts for the policyholder and all office records and statistics.

The system covers practically the whole field of administering records, calculation of premiums, submission of accounts, accounting for premiums received and outgoings, and valuation of reserves in respect of membership of group life and pension schemes.

No attempt has yet been made to deal with actual pensioners nor with the calculation of pensions or other benefits arising on retirement or death. The chief reason, as to determination of claims, is that in many cases entries cannot immediately be made on the record cards until various formalities, usually of a statutory nature, have been complied with. Further, certain options often become exercisable on the occurrence of a claim and considerable correspondence ensues. As to the production of annuity warrants and so on, this is a large-scale print job for which the equipment on the 405 was not designed and it remains on Adrema plates.

SNAGS WERE RIFE

What do the Legal and General people say of their experience?

'So far as reliability of the machine is concerned it is certainly not perfect but, in that, it is probably not unlike other machines,' says Mr Jecks.

'As one of the earlier first-generation machines it contains hardly any of the self-checking features popular in more recent designs and so if any spurious pulses are picked up or lost in an area of the store which holds the program the machine

can run wild. This doesn't happen often and we have learned, the hard way, to protect ourselves by having the program put out at regular intervals—say, 20 minutes or so—any running totals accumulated and the settings at these points of any program switches.

'Thus if the worst should happen a restart point is available without re-running too long a period of program. In new jobs break points are included as a matter of basic routine and the initial planning of the program.

'Some faults remain mysteries. A program will run sometimes without trouble and sometimes it won't and we don't quite know why.

'Our experience of magnetic film has been extremely good.

'Our custom is to include a check total in the last word of each block—a total of all the binary information in the block—and by programming this check total can be obtained and checked without have to stop the film.

'We always program so that if there is a sum check failure the film is backed up and read again, and if the sum check is satisfactory the second time we accept it. If it fails twice we stop and investigate. Probably the very occasional sum-check failures we have had have been caused by specks of dust or grit on the film on the first passage through the heads. But we suffer little from dust on the reading heads, partly because our films, unlike some types of magnetic tape, do not run in contact with the heads.

ONE ERROR PER MILLION

'We don't use high-speed line printers, bulk output being converted off-line from film to paper tape which drives Flexowriters. This sounds a long chain of processing but it gives very little trouble and we have achieved an accuracy of about one error in a million characters. Of course in more modern machines error detection is built in at practically every stage.'

'We use only paper tape for input and, robust and reliable though this may be for communications work, the manufacturers have still some way to go in improving its accuracy for computer operations.'

'Initially we discovered fairly frequent errors in punching and especially in verifying but after modification the punches and verifiers seem to be behaving quite well. Still, a payroll for, say, 5,000 employees, each pay slip containing up to 200 characters, means a total of about a million characters and we do want at least an odds-on chance of getting it right. We don't want to have to expect at least one error in a payroll every time we do it.'

COUNTER INFORMATION

— Does the retail industry want it?

Of all commercial endeavours in the American business community, perhaps the most cautious in applying automatic methods to its data handling and accounting problems has been the retail trade. While the larger stores and store chains have used punched card tabulating systems for well over ten years, the use of computers and point-of-sale recording equipment is still scarce, the few users at present being solely department, accessory and shoe stores. Yet point-of-sale recording may well be the key to wide scale employment of automation in retailing.

Essentially there are four elements of retail accounting and control which are dependent on information collected at the point of sale. These are:

- Accounting for cash;
- Accounts receivable book-keeping for non-cash transactions;
- Merchandise control;
- Sales compensation or payroll.

Accounting for cash in any business is of course vital. The importance of getting the right cash for sales made is obvious, and the time-honoured method of control has been that of checking actual cash (and cheques) in the cash drawer against the printed cash register sales journal and/or a tallying of individual sales slips. While the multi-drawer cash register has been used to determine the accuracy of entries of individual sales personnel, such usage is limited.

The increase in the number of sales transactions for other than cash has grown tremendously over the past ten years. While many retail store businesses are still essentially cash and carry operations (variety, food, drug, proprietary and wine and spirits stores fall in this category), the growth

in charge or credit sales among department, dress, furniture, appliance and jewellery stores, and petrol service stations has been significant, making the performance of the accounts receivable book-keeping function one of the most tedious and costly in store operation.

An idea of the cost can be gained by referring to a recent report compiled by the Graduate School of Business Administration of Harvard University*. In the average department store with more than \$1,000,000 in annual sales, non-cash sales represented about 55 percent of total sales, with accounts receivable book-keeping and credit personnel costs representing 2.1 percent of sales. Since the average net earnings before taxes among these stores was about 4.5 percent, the impact on profit leverage which a reduction of personnel costs required for this account receivable book-keeping function would produce is obvious.

Merchandise flow control is considered by many in retailing as providing the greatest leverage on store profits, as proper control can reduce the ratio of inventory to sales and reduce the merchandising markdowns. (Again referring to the Harvard Report, the average store reported its markdowns averaged 6 percent of gross sales!) Merchandise flow control implies several control and accounting operations: inventory status control; gauging the rate or trend in sale of soft goods in terms of size, style, colour; gauging the impact of 'loss leaders' on sales of other items, and so forth.

Many retail sales personnel are paid on a commission or part commission basis. While the trend toward self-service operations (particularly in food, variety and general merchandising stores) will reduce the requirement for recording of sales

* Operating Results of Department and Specialty Stores in 1959, Harvard University Graduate School of Business Administration, Soldiers Field, Boston 63, Massachusetts.



Previous 'American Reports' have examined the idea of—and the devices for—tapping information at the point where it is originated in manufacturing operations. Applying this idea of recording data at source in machine language to the retail trade (that is, recording information at the counter or 'point-of-sales') is excellent in theory but in practice there are stumbling blocks

for purposes of determining commission payments, this requirement will persist in areas such as appliances, furniture, men's clothing, etc.

COLLECTING INFORMATION AT THE POINT-OF-SALE

In order to effect the accounting and control functions mentioned above, a variety of information must be recorded at the point-of-sale.

1—Merchandise Information:

- What was sold?
- How many?
- Unit price
- Discounts (if applicable)
- Taxes (if applicable)

2—Customer Information:

- Who made the purchase?
- Carry or delivery?
- Cash or charge (or lay-away, etc)?

3—Store Information:

- Date
- Department
- Sales person

Certainly not all of the information listed above has to be collected for all sales in all types of stores. Probably the demands of the department and accessory stores are greatest in this regard. Yet, even in the supermarket type of food store, recording of some of the above information can aid in the performance of merchandise control (and thereby facilitating, for example, a form of automatic stock replenishment from warehouses). And while in some types of stores (such as variety) control of sales in terms of dollars, not units, is more realistic, the classifications of the merchandise sold can prove very helpful in merchandise control (answering such questions as when and

how much to buy, inter-store transfer of merchandise, etc.).

PAST APPROACHES

The essential ingredient in point-of-sale recording is the capturing of pertinent information concerning the transaction in a form which permits processing by tabulating equipment or computer without further human intervention or interpretation, *ie.* collecting the data at the source in 'machine-readable' form.

The fundamental approach in the past of the various American manufacturers who have developed and are marketing point-of-sale recording equipment has been to ally a cash register or adding machine operation with the preparation of a by-product punched paper tape, so that later the tape could be converted to punched cards for tabulation, or fed directly into a computer. Two manufacturers (American Totalisator Division of Universal Control Corporation and Radio Corporation of America) have developed recorders which can be wired directly to card punches or computers.

The advent of pre-punched merchandise tags, whether or not a point-of-sale recording device is used, has helped a great deal in providing information for merchandise control purposes. Several of the point-of-sale recorders available (as is indicated in the table on page 25) make provision for reading of these tags.

While the advantages of point-of-sale recording have been widely heralded and accounting executives in the retail trade certainly wish to capture information at source to help eliminate inaccuracies and reduce cost in book-keeping, as well as provide information for better merchandise control, the acceptance of such equipment has been limited.

continued next page

Many large department stores have 'experimented' with recorders over the past few years, but today there are relatively few installations of such equipment. The logical question to be posed is: 'If retail stores want what point-of-sale recording equipment can provide, why is there not extensive use of such equipment?'

There is no single best answer to this question, but there are several factors which have undoubtedly influenced this 'foot dragging' approach to use of point-of-sale recorders; namely: the extent of existing automation of accounting functions, cost, the requirements for recorder operation, resistance to change, and perhaps the 'panacea' approach to store accounting and control which many recorders attempt to provide. Let us consider each of these factors.

1. *The extent of existing automation of accounting functions.* Although that application of point-of-sale recording is probably the key to expanding the use of automatic data processing methods in retailing, the consideration of use of such equipment is naturally predicated on having data processing equipment (or using a data processing service bureau) for performing the normal accounting functions of accounts receivable book-keeping, billing, inventory control, sales analysis, and the like. One does not require point-of-sale recorders to perform accounting functions, but one must have the use of data processing equipment, punched card tabulators or computers in order to justify point-of-sale recorders. As was mentioned previously, the use of computers in the retail trade is highly restricted at present, the use of punched card tabulating systems moderately extensive among medium to large size establishments (say over \$15,000,000 in annual sales) and sparsely used by the vast bulk of retail operations. Thus, while point-of-sale is the key to automation, the extent of automation is an inhibiting factor on the use of point-of-sale recording equipment.

2. *Cost.* When we speak of cost, we must consider not only the cost of the recorder, but also the cost of the conversion equipment, if such is required, and the cost of data processing equipment. The current cost of several of the recorders available is roughly that of conventional cash registers. Yet the cash registers are in place and are 'work horses' requiring minimum maintenance and providing long life. As a result, purchasing of replacement equipment on any wide scale basis would require a considerable outlay of capital.

Conversion itself is another moderately costly factor. Since most recorders produce a binary coded tape which must be converted to punched cards for tabulator use or to punched cards or magnetic tape for computer use (with few exceptions) the user must invest in conversion equipment.

The cost of data processing equipment is becoming less of a factor, at least for punched card data processing. Yet computer costs (and certain aspects of merchandise control exceed the capabilities of punched card systems) are still high in relation to the means of the vast majority of retail establishments.

3. *Requirements for Recorder Operation.* In order to gain the desired information in the by-product media of point-of-sale recording, a considerable number of operating steps must be undertaken, whether they entail machine reading of templates and tags or manual keyboarding or a combination of the two. But retail sales people are not book-keepers. Their general level of education is low. Most of them are women, their rate of turnover is high, and also the use of part-time help is extensive. Therefore, any recording device must be simple to learn, simple to operate and must allow for rapid use at peak periods. In the opinion of many retail executives many of the current recorders have not been 'human engineered' to account for the nature of the personnel who will use them.

4. *Resistance to Change.* The most vocal group aware of the need for, and advantages of, point-of-sale recording are store comptrollers and accounting managers. However, the buyers and similar personnel responsible for day-to-day operations on the selling floor have yet to be so convinced. Thus the recorder equipment manufacturer has to 'educate' floor personnel, to break down well-established methods and attitudes and to overcome the lethargy which is particularly excessive in retailing, especially in the soft goods lines. Such efforts demanded of the manufacturer are quite costly and, as a result, he must approach the problem slowly, lest his marketing costs destroy any profit prospects.

5. *The 'Panacea' Approach.* As mentioned above, there are several retail accounting and control functions for which point-of-sale recorders can provide information: cash accounting, accounts receivable book-keeping, merchandise control and possibly sales compensation. However, the performance of these functions is not simultaneous. They are distinct functions, which, while they may require some common information, are normally performed by separate groups of accounting and other store personnel.

As a result, the attempt of several recorder manufacturers to provide for the capturing of all information through one recording device may be impractical, with the breaking down of the recording problem into its end result component requirements perhaps more practical and more

POINT OF SALE RECODERS CURRENTLY AVAILABLE

Manufacturer	Type of Keyboard	Customer Identity Plate Reading	Clerk Identity Plate Reading	Merchandise Tag Reading	Media Output
American Totalisator 'Uni-Tote'	Bookkeeping machine type	Yes	Yes	Dennison Kimball	Direct to card punch
Clary 'Transactor'	Full keyboard adding machine	None	None	None	Punched paper tape
Monroe Monroe Cash Register Sweda	Cash register Full keyboard adding machine	None None	None None	None Kimball,	Punched paper tape Further data punched into Kimball tag Punched paper tape
Sweda	Cash register	None	None	None	
Minnesota Mining & Mfg. 'E.M.C.'	None—wired to cash register or separate keyboard	None	None	Dennison	5 Level binary code on 16 mm ThermoFax paper (special con- verter reads tape for conversion to punched cards, etc.)
National Cash Register	Cash register 10 key and full key- board adding machine	None	None	Dennison Kimball	Punched paper tape
Radio Corpora- tion of America	10 key	Yes	None	Dennison	On line to computer
Remington Rand 'Point-O-Sale Recorder'	10 key	Yes	None	Dennison Kimball	Punched paper tape
Victor	10 key	None	None	None	Punched paper tape

acceptable from the stores' standpoint. For example: merchandise control demands such information as: what was sold, when it was sold, and what did it cost; whereas accounts receivable book-keeping requires: who bought it, when, for how much, with only a general description of the article purchased.

This evaluation of the status of point-of-sale recording does not imply that many of the recorders currently available do not have useful application. They do. However, here the concern is to evaluate the factors and considerations which do influence the receptiveness to point-of-sale recording which, in the final analysis, can only be measured in terms of the extent of actual use.

FUTURE CONSIDERATIONS

Certainly many of the limiting factors discussed above must be overcome if the retail trade is to gain the distinct advantages which point-of-sale recording and automation offer. Perhaps the most significant step in this direction is the plan of several manufacturers to apply the principles of

character recognition or optical scanning to recording, through the reading of cash register sales journals and individual sales slips. Unit data collection (for purposes of merchandising and inventory control) using pre-punched merchandise tags might be handled as a separate operation. A centrally located scanner could read cash register sales journals to provide control totals for cash accounting (and perhaps for sales analysis purposes) and read sales slips for the accounts receivable book-keeping information required. This approach would tend to divide the problem into its natural accounting and control components, permitting the use of existing equipment (cash registers and pre-punched merchandise tag systems) and requiring no new learning on the part of sales personnel.

While the application of optical scanning would appear to overcome some of the objections to current point-of-sale recorders, the factors of 'extent of automation,' 'cost' and 'resistance to change' must still be faced before widespread retail automation can become a reality.



‘Just One Moment, Sir While I Ask the Computer’

Cases have recently been cited in the national press of airline passengers arriving at airports to find that although they have tickets for a specific flight, there is no accommodation available on the aircraft. This sort of mishap is caused by inadequate control of seat reservation information between widespread points on an international network. With an electronic computer as the hub, SAS have devised a system which will eliminate the possibility of this sort of thing happening on their services

P W Black

WITH the advent of jet air-travel for regular passenger services, airline operators are having to streamline their administrative systems to ensure full use of the increased capacity of their fleets.

One airline company which at present has a short lead over its rivals is the Scandinavian Airlines System which has achieved greater efficiency of operation by using an electronic computer as part of an automatic seat reservation system.

Basically, this computing system is a vast electronic file which retains complete information on all of the company's flights throughout the world. At the push of a button, any of this information is immediately available to seat reservation offices hundreds of miles away.

The computer is housed at the seat reservation control headquarters in Copenhagen, and is at present connected to Scandinavian Airlines' branches in six other European countries, including London.

The seat reservation control system works in this way: when an enquiry for a specific journey is made at a local office, a reservation clerk contacts the computer and asks for information regarding space availability over that route. The request and reply takes only a few seconds. For this, each local centre is equipped with a manual key-set about the size of a portable typewriter, connected to the computer by a teletype-cable link. Together with each key-set is a batch of destination plates. These are perforated cards, mounted on metal plates, which are master records of every air-route covered by the company.

To establish contact with Copenhagen, one of the destination plates is inserted into the key set. The date, flight sector and class of flight are recorded manually on the machine and the 'ask' button pushed.

Within a few seconds the central memory has processed the information and, not only provides an answer for the specific flight requested, but also gives the situation of accommodation on nine other alternatives.

All the information from the computer is displayed as a combination of red and green lights located on the key-set itself. A green signal denotes ample accommodation; a red light means that the flight is full; and a combination of red and green indicates that there is very little space available and any booking must be checked with headquarters for confirmation.

Following a go-ahead signal, the reservation clerk writes the full particulars of his clients, and their needs, on conventional documents. This is transferred by conveyor belt to a communications room, and here teleprinter operators despatch the fuller information to seat reservation control in Copenhagen.

In London the SAS offices in Conduit Street have 31 teleprinter machines and associated equipment working 24 hours a day. Transmission of seat reservation data is only a fraction of the work undertaken, which includes the receipt and distribution of details about SAS aircraft all over the world.

Therefore, when an interrogator set in London asks for connection to Copenhagen, the normal teletype service is momentarily interrupted, and the circuit connected to the computer. After a few seconds normal working is automatically restored. The information from the computer is retained on the key-set by a special holding circuit and can be cleared by an operator, thus little delay is caused to teletype traffic. Using the one cable-link also saves the cost of an additional inter-city line.

In Copenhagen the teletyped reservation details are received on perforated tape which is then fed into an IBM tape-to-card converter.

Shortly before a flight is scheduled for departure, the cards for that flight are automatically sorted. A card-to-tape converter then produces a complete passenger list in paper tape form which is transmitted to the station where the flight originates.

Controlling 'midnight sun' trips

Before the introduction of a computer, a vast peg-board control method was in operation at each of the company's main offices. Last year Scandinavian carried more than 1,600,000 passengers, and to cope with all the information involved, it was impossible to carry full flight details for more than two or three weeks ahead. Now, it is possible to know the accommodation position on individual journeys for the next three months.

The new system also includes facilities for incorporating non-scheduled journeys, such as the flights to 'the midnight sun,' operated in the summer from more northerly airports.

The branch office manual keyset is no larger than a portable typewriter



SAS's present system is an information rather than a booking system, and as firm bookings for flights are confirmed, the information is relayed to Copenhagen so that the stored information may be 'edited.' This is done through this push-button control unit.



The teleprinter was used as a communications link with the peg-board system. But even so, the board was often several hours behind with its information. In jet travel a few hours are all important. Since the introduction of the Caravelle airliner on relatively short inter-city hauls in Europe, timetables have been drastically revised, and the number of journeys made increased. Being an hour or two adrift on data can radically interfere with the effective operational control of the fleet.

Now, last-minute cancellations and alternative bookings can be handled quickly. This is particularly rewarding with aircraft making a series of relatively short hops, and where its passengers are frequently changing.

Apart from their own schedules, SAS also has agreements with other airlines. Over shared routes, they co-operate in devising a time-table that is mutually beneficial, and on routes not operated by Scandinavian arrangements are made with the local operators for connecting services.

Details of these schedules are also retained by the electronic file, and can be obtained by using the standard interrogation technique.

At the moment, the computer can only be questioned as to the amount of space available on each flight. It does not automatically deduct each reservation made from the total number of seats recorded. Editing of the stored information is done manually via a push-button control unit in the central reservations office.

Facilities for the eventual complete automation of the system, however, are incorporated in the equipment. Before this is brought into operation, there are still several major seat-booking points to be brought into the network and, until these are introduced as an integral part of this international system, thus providing a complete coverage of all scheduled routes and airway links, fully automatic control would not function efficiently.

An automatic seat reservation system was installed by an American airline earlier this year, but only for operations within USA. The SAS

network, developed by the German company, Standard Elektrik Lorenz, is the first international data handling network of its kind.

Britain's two leading airlines—BEA and BOAC—however, have been developing a similar system with a British communications firm. These are both to be brought into use during this year. One of them will start with the simpler interrogation technique, but the other will be a fully automatic method from its inception.

Systems for other users

Although the Standard Elektrik equipment has been developed for a special purpose, it could equally well be applied to industry and commerce. In the past two years, many users of electronic data processing equipment have been demanding equipment for the transmission of financial and commercial information. One of their specifications has been a high degree of accuracy and, until now, teleprinter services have been considered inadequate, but the Standard Elektrik equipment has allowed for the error potentialities of these lines.

Long-term investigations of these cables has revealed that there are two common faults. One is cable breakdown, and the other is a relatively long-term interference lasting several seconds.

When a circuit break occurs, the transmission equipment automatically locks and retains its information until normal operation is resumed. Gaps of this nature are infrequent and usually last a matter of minutes. In no way, however, are the data affected.

Yet interference or error bursts, do distort the digital information carried by a line. As they are, however, of a long-term character this distortion is so bad that the information becomes gibberish, and this is, therefore, automatically rejected by the system and the message started afresh.

Several organisations, that have used teleprinter links for data communications, have affirmed that it is a very rare occasion when one character is changed during transmission.

What do these men have to offer?



Crownshaw: '...They tend to want to transfer routine things to the computer.'

As more and more data processing systems are developed it's a straight bet that many more executives are going to be quietly besieged by salesmen. What is the salesman's pitch? What value does he put on the equipment he is trying to unload onto you? To find the answers to these and other questions, our correspondent Robert Spark interviewed a number of computer salesmen, and the result is a series of profiles of the men who will be knocking on your door during the next few years, explaining what they think and how they work. The first three of these profiles are published below.

JACK CROWNSHAW

JACK CROWNSHAW is head of the commercial sales team for computers at the National Cash Register Co. Aged 46, tall and genial, he bears the stamp of an NCR salesman—and that is in no way a disparaging remark. He is married and lives at Watford. His career began in 1928 on the London, Midland and Scottish Railway. From 1931 until the war he was in the General Manager's office at Euston on organisation and methods work. Then, after six years in the uniform of the Royal Engineers, after the war he decided to make a change and joined NCR in 1947. His pre-war position at Euston had brought him into touch with the company and, following 18 months as an accounting machine salesman in Manchester, he returned to London as a specialist in transport accounting. Logically, he became responsible for sales of keyboard accounting machines to nationalised transport.

As the application of electronics to office systems and equipment began to take shape, so did his interest in this field. As a result, he was connected with the computer side of the business from the start of NCR's association with Elliott Brothers in 1955.

Now he has a group of investigators or systems analysts under him and access to a group of specialists.

Mr Crownshaw must, in his job, be able to meet and deal with people at many levels from chairman and directors down. He must be able to stand up in front of a skilled and knowledgeable group of executives and answer questions—and convince them that he knows what he is talking about. In his position he undertakes the first discussion with a prospect prior to allocating a systems analyst. This in itself requires care as the right analyst must be attached to the prospect. From this stage on, Mr Crownshaw maintains a watching brief, ready to assist where necessary with any aspect of the operation. If the company is successful in obtaining the order then it is his job to co-ordinate all the services required to bring the installation to its final working state.

As a computer salesman Mr Crownshaw has to stand up to getting an order only at infrequent intervals compared with, for example, his colleague selling keyboard accounting machines.

To keep him up to date on the company's technical developments, NCR provide training courses, while a system of circulars is used to keep him informed of minor changes. These are supplemented by meetings and by reading and discussion. Computer development is, of course, continuous and as a result Mr Crownshaw must always be learning. This, he thinks, makes him more mentally agile and alert and avoids 'middle age stagnation' which so often grips the over-forty executive.

General developments in the computer field are assimilated because he spends so much of his life talking about the subject with colleagues, clients and prospects.

The pattern of selling computers must necessarily be complex. The initial task of finding the prospect is, for NCR, perhaps simpler than for some other concerns. Their extensive list of customers of their cash registers and their accounting machine equipment provides an open door; there is no cold canvass for them. Usually, however, the initial enquiry comes from the customer and the first move is a discussion with a senior executive. This is to discover the terms of reference and also to ensure that the prospect is aware of the problems involved in the installation of a computer. Next comes the allocation of a systems analyst who will be the 'investigator.' If NCR are given a complete specification this will reduce the analyst's job to one of only two or three weeks' duration. If the investigation is more involved it may last many weeks. At any time the systems analyst can call on technical experts to aid him. When his task is complete, a final report is produced and on this a specification is drawn up and a price—anything from £30,000 to £333,000 worked out. In time, anything up to 12 months may have passed from the original enquiry and if the prospect signs on the dotted line there is probably at least two years' work ahead.

The customer, before his computer starts working, receives a considerable amount of aid on such things as site, personnel and training. The latter forms a large

part of a computer firm's business. Training includes technical courses, systems work and programming.

Only one application

What of the selling; is it 'soft' or 'hard'? 'When I go into a prospect,' says Mr Crownshaw, 'I do not try to sell him on other applications at this stage. Probably there will be a stage when he can be told of other uses.' In the same way Mr Crownshaw does not attempt full integration at the beginning—the customer is, he believes, better with a single application which pays off in terms of management as well as straight £ s d.

On British firms' awareness of the value of the computer, Mr Crownshaw has this to say: 'Currently, industry is not fully alive to the potentialities and capabilities of computers. They tend to want to transfer routine things to the computer which simply saves labour.' The anxiety to make the computer installation pay for itself sometimes pushes other longer term tasks into the background. For this Mr Crownshaw blames conventional thinking.

He believes that future developments hinge on the market a firm is tackling. In the lower and medium price ranges you have a much larger slice of the market and this is, essentially, the NCR market. Trends? He believes there is a tendency towards smaller and cheaper file storage machines and possibly a marriage of electro-mechanical devices. The immediate advance would be the ability to read ordinary printed matter direct into the computer—which is not far away.

HARRY JOHNSON

HARRY JOHNSON of Ferranti Ltd is a man without a title because, as he says: 'Ferranti are enor-

mously free from a rigid structure and ranks and levels are not so important as with other concerns.' This, in itself, provides a clue to the sales approach of the computer side of the Ferranti

business. Mr Johnson, aged 37, is a quiet and reasoned speaker. He has the knowledgeable-without-frills approach of the scientist, rather than the salesman. Married, he lives at Herne Hill.

After taking a University degree in mathematics he joined the Civil Service as a scientific officer. At one stage he was engaged on looking into the use of computers for air traffic control purposes. This brought him into contact with computers—at the National Physical Laboratory—and in turn, he came into touch with Ferranti. Once his interest in the subject was aroused, he decided to become more closely associated with it and the upshot was that he joined Ferranti in 1954.

Initially concerned with defence projects, he did some logical design and after a year, started taking an interest in commercial applications. He is now in charge of the commercial sales group.

Mr Johnson regards computer selling in the same light as selling capital goods. It is a highly specialised form of selling for which, Mr Johnson says: 'You don't have professional salesmen, you have people with computer skills.'

A watching brief

Mr Johnson usually follows up a basic enquiry himself, taking one of his staff with him. After this his position is that of holding a watching brief. Frequently he sees staff from a prospect while he may have to attend meetings up to boardroom level. In fact the people he may see can run from junior O and M staff to chairmen.

He maintains close contact with the engineering group and this is achieved in a number of ways. For example, new projects are directed by teams who are a mixture of engineers and programmers—the latter being in the computing sales group. Programmers therefore act as a bridge between sales and engineering. There are also more formal meetings between the two groups which are, in effect, sales policy meetings.



Johnson: 'A firm must work out its own salvation as far as computers are concerned'

Mr Johnson is kept up to date on what his competitors are doing through information which is circulated within the organisation but, he says: 'We don't make a fetish of studying our competitors.'

Their volume of enquiries is sufficient for them to cope with without knocking on doors. Occasionally they will circularise an industry regarding a specific application, but this is more often on the scientific side of computer use. From time to time they arrange 'at homes' for specific industries—one-day sessions to explain what they are doing. 'These produce good results,' reports Mr Johnson. He finds that when people are considering the question of a computer they will examine the products of a number of firms and in many cases you never know why you have been contacted.

Ferranti are great believers in the premise that a firm must 'work out its own salvation as far as computers are concerned.' When someone installs a computer they must have a team who knows how to use it.

Mr Johnson has found that

their prospects divide themselves into three fairly distinct categories:

- 1—Government departments who tend to be a law unto themselves.
- 2—Firms that take a similar approach to government departments in that they provide a detailed outline of what they want.
- 3—Firms who want information so that a proposal can be put up to their respective boards.

Prospect decides on profitability

In each case the prospect is allocated a salesman who can place all the facts before them. However, Ferranti feel that it is not up to them to prove profitability of an installation—it is the prospect's job to decide what savings a computer will offer. When the company makes its proposal it will be very specific and carefully engineered to the prospect's requirements. Mr Johnson likes the prospect to send a group for a programming course at a very early stage (before embarking on a feasi-

bility study). This course usually lasts two weeks and its value, says Mr Johnson, cannot be overstressed: it is 'good basic computer education.' This whole approach leads to the prospect being able to say, quite clearly, what he wants, rather than Ferranti going into the firm and telling him what they should do. Of course they often make counter proposals for the better use of equipment. Negotiations usually follow the submission of a quotation and then comes the order.

Work for 'insiders'

At this stage the programming service group comes into the picture and takes over responsibility for the systems and programming side. They try to guide the cus-

tomer into transforming proposals into practice. Mr Johnson believes that this work must be done by people 'on the inside' who are closer to the actual problems involved.

One member of the group is normally allocated to the customer until the installation is in and working, and he will be reinforced immediately before and after the equipment goes in. The role that such staff play is that of consultants or advisers. In the sales group are experts on site preparation, while the engineering group have a technical service to aid the customer. They also undertake maintenance contracts if required and any modifications necessary.

Ferranti have been principally concerned with the larger type of order costing anything from

£150,000 to £350,000 and they are wedded to the idea of the big computer. They do, however, see the possibility of people sharing an installation or using service centres. They also find that people buy a computer for one purpose and extend it to other applications.

Mr Johnson does make the point that: 'A lot of people are using them unimaginatively, but I don't think that is the case with our customers.' This is not smugness but relates to the size and type of computer equipment they market—and in turn the uses it is put to.

As for the future, Mr Johnson thinks that the control of machines and processes are of growing importance. 'We think the breakthrough may be greater in the industrial sphere,' he says.

MIKE STAMMERS

MIKE STAMMERS is a deputy manager of the computer group of International Computers and Tabulators Ltd. His office is near the top of ICT's new computer centre building overlooking the Thames at Putney Bridge. He answers questions in a way which shows that he is used to imparting information to individuals and to groups on the subject of computers. In a building devoted to the computer, he fits in well as an organiser, adviser and teacher. Aged 41, married, and living at Woking, his first job began in 1938 when at the age of 19 he joined a firm of accountants. The war cut short his stay and he spent 6½ years in the services. After demobilisation in 1946 he joined the British Tabulating Machine Co and became a technical adviser. Two years later he was promoted systems adviser, a position he held until 1952. During this period he undertook several trips overseas

—including visits to Hong Kong and North and South America. In 1952 he was promoted to area manager for Kent and after two years was transferred to the post of 'government section manager.'

It was at this stage that he came into contact with computers and received some training on their applications and potential uses. The company had some success with the sale of computers to the Government and this served to identify him more closely with this particular aspect of British Tabulating's activities. When the company formed a computer centre in 1957 he was appointed manager. On the merger of Powers-Samas and British Tabulating in 1959, he became deputy manager of the computer group.

He is particularly associated with public or, to be more accurate, prospect relations. He gives frequent talks, is often in contact with customers and prospects and spearheads the group on the subject of training. In addition, he has normal management responsibilities, in-

cluding visits to area offices. His job brings him into constant touch with people and he is, in fact, the spokesman for the computer.

Whereas he spends a proportion of his time imparting knowledge of the computer, he is equally keen on keeping abreast of developments. The circulation of written material—internal and external—keeps him up to date and he follows the progress of competitors closely. ICT's research and design and planning division provide him with information on developments within the company.

Geographical coverage

Mr Stammers claims that ICT differs from their competitors in that they have a 'field sales' organisation with something like 29 area offices. These are self-supporting offices covering the entire range of products. In command of an area office is an area manager, usually fortyish and the elder statesman type. He has two managers under him—a

sales manager and a service manager, who are responsible for the pre-order and post-order stages respectively. Under the sales manager are systems advisers, plus technical advisers—such as machine technicians, who design documents, cards, plugboards, etc. The systems adviser is principally associated with the prospect's application while the technical adviser is connected with the equipment.

The combination of the field sales force handling all products and the rapidly changing computer field has resulted in the computer group. There are some 200 people in this group, all experts of one sort or another. Two-thirds of them support field sales and the remainder act as a clearing house for future developments—an important by-product of the main activity.

Like some of their competitors, ICT have a large customer list from which emerge many of their

computer prospects. *Long association with ICT and its constituent companies is a powerful incentive for some potential computer users who are sold on continuity of supplier.*

Initial interest can, however, come from many different sources. The first conversations usually take place between the area manager and the prospect. This leads to a computer appreciation course at the ICT school. Usually a younger executive takes a programming course. The prospect's key executives will visit the computer group centre at Putney. In anything from half a day to four days, they try to hammer out what the computer is required to do. From this discussion emerges some idea of the size and scope of the proposed installation and, in turn, this leads to the putting up of general proposals. Then comes the definite proposal stage, sometimes based purely on the

'hardware' and at other times including the 'software' as well. On this a decision is usually taken by the prospect.

Once an order is placed work starts in earnest. There is a council of war to discuss delivery of the 'hardware.' Then, the first tasks to go on the machine are worked out. A training scheme is mounted for the client firm's executives which may extend, intermittently, over six or eight months. Mr Stammers believes it is important to guide the client firm on the selection of staff. He also lays emphasis on teaching clients how to use their equipment: ICT train 5,000 people a year. This is closely linked to their belief that the client's staff must do as much as possible themselves and be fully self-supporting at the earliest opportunity.

Mr Stammers believes the prospective computer user should initially go for one or two straightforward applications. In fact, most people do this. On the use of the computer, he believes that in the short term there is nothing to beat straightforward data processing—but long term application is really the more rational approach. 'Some people don't need telling,' he says, 'they are there in one on what they stand to gain from the use of a computer.'

Stammers: 'Some people don't need telling'



FEBRUARY 1961

SURVEY

Part V of the Survey of ADP equipment which deals with 'optical scanning' is being held over until next month.



Who Wants What?

JANUARY was the happiest month, holding out ample opportunities when a qualified young man's fancy could turn to thoughts of more money. There were, for example, something like 35 organisation and methods jobs to be filled, and although not all of the advertisers were specific about salaries, the progressive ones offered from £800 (for junior O and M assistants) to £1,600 a year (the latter figure was bid by British Railways [Scotland] who required an experienced man as a senior O and M assistant). For anyone still doubting that computers were having a strong impact on the market for O and M people, the writing was certainly on the wall: out of 25 advertisements 10 specifically mentioned the work involved would be linked up with computer or punched card data processing, and a further eight of the advertisements were from organisations whose O and M departments are either just being set up or expanding. The thumbnail job profile that emerges from this batch of advertisements indicates that an O and M officer with two to three years' experience, aged from 25 to 35, can expect between £1,000 and £1,250 a year.

Programmers were again in firm demand—some 25 jobs were open to tenders. A number of

the advertisers, such as Dunlop and Glaxo Laboratories, were prepared to train people without experience, but the majority were seeking experienced men. Salaries, where mentioned, were usually just over the £1,000 a year mark, and the plum-of-the-month was probably the one offered by a secretive company who baited their offer for a chief programmer with £2,000 a year.

One aspect young O and M assistants can bear in mind is that the dividing line for some firms between O and M and programming jobs is often blurred—for example, Sainsbury were recruiting an analyst/programmer last month—so that experience of both techniques not only broadens one's scope, but may be the key to future promotion in any one of about three directions.

Accountants, of whom we keep track because of the bearing automatic data processing so often has on a company's accounting procedures, were not greatly sought after this month—at least, ones likely to be concerned with data processing installations.

By contrast there was a brisk demand for operational research workers. Of the 15 jobs offered the majority were from organisations who have long been known to have OR departments or

sections. For example, United Steel, BISRA, and BEA all featured, but there were also some new names such as Decca Radar (who needed an OR team leader) and Gillette. This is a significant feature, for as more companies become 'sold' on OR, there is bound to be initially—in fact there is already—a shortage of qualified OR men.

BSA wanted a man to start and head an OR department and held out £2,500 a year, and the two other organisations that were not too shy to mention salaries in their advertisements—the Central Electricity Generating Board and Littlewoods Mail Order—held out £1,630-£1,890 and £2,000 a year respectively.

In all cases the qualifications required were high: a degree in economics, mathematics or physics and some years of experience.

Under the heading of 'miscellany' a large stack of advertisement cuttings accumulated during January. These advertisements refer to (a) jobs with computer and data processing equipment manufacturers (b) jobs as computer department manager (c) jobs as punched card installation supervisors or managers, and (d) jobs with professional consultancy firms. The opportunities were there.

The Programmer's Task

Condensed from one of the chapters from a forthcoming book* by J F Davison — 'Programming for Digital Computers'— which will be published at the end of this month

IN considering the progress of a typical piece of work carried out on a computer, six stages can be distinguished, as follows:

1. The initial concept of the task to be performed.
2. Deciding on a suitable computer method.
3. Writing the program.
4. Development of the program on the machine with test data.
5. The initial production runs of the program.
6. Handing the program over for routine work by operating staff.

In practice of course there may be considerable variations; some of these stages may disappear and others creep in. For instance, if the job has already been programmed for another computer, the first stage will not be required, nor will the second unless the method used before was unsuitable for use on the second computer. Again, a very similar job may have been done before on the same computer, and this may get rid of the first two stages and part of the third.

On the other hand, it is sometimes possible to divide the third stage into two or more parts, each part being done by entirely different types of people; this practice tends to be associated with particular computers, or with particular computing groups.

The last stage can disappear in a certain type of

organisation, such as a research institute with many continually changing problems, of which few ever become regular jobs.

This article will be devoted to considering these six stages and indicating the decisions which have to be made at each.

1. *The initial concept of the task to be performed*

As a definition it is usual to say that a computer can do any calculation capable of being reduced to a routine process in which each step can be set down clearly and unambiguously; the computer can make any necessary decision as to what the next step should be provided it can be laid down in advance what the next step is to be in all cases that can possibly arise. This of course is a very wide definition, and in fact a list of all the jobs for which computers have been considered would be a long one.

In most cases where a computer is being considered for a particular application, the real question is whether the computer can do it economically rather than whether it can do it at all. The same point arises in trying to define the exact boundaries of the job to be performed, once it has been agreed that the job should be done; the computer's capabilities are such that it is always possible to visualise it taking over more and more of the job. This point arises most clearly in business applications where, having decided to do a factory payroll as a regular computer operation, it is tempting to extend it to include costing, as the

**Programming for Digital Computers* (Business Publications and Batsford) 35s. from bookshops or 36s. 3d. post paid from Business Book Centre, 109-119 Waterloo Road, London, S.E.1.

components of each pay packet are in fact costs to be allocated to particular factory jobs.

With technical application it is often much easier to see 'natural' boundaries to the job to be tackled, and the stage of deciding just how far the job extends is much less difficult.

It is sometimes possible to make radical changes in the job being tackled at quite a late stage. Difficulties may occur at the programming stage which make changes in the concept of the job imperative, or, conversely, some neat solution to a problem may come up making it possible to do the job as a by-product of something already being done. It is always advisable for those who make decisions as to what job should be tackled on a computer to have some knowledge of programming.

As mentioned above this stage of deciding what the job is becomes much simpler if the same job has been done on another computer or a similar job has been done on some other occasion.

When copying a job from another computer it is often possible to make improvements to the details, but providing these are restricted to minor points, and providing the two computers are not too vastly dissimilar, there is little scope for discussion over what the job is or how it should be done.

2. Deciding on a suitable computer method

There are two general points to note at this stage. Firstly, the best method of doing a job on a computer is not necessarily the same, and may be very different from, the best way of doing it without a computer. Secondly, what is best does not depend solely on the characteristics of the job and the machine, but also on the quality and quantity of the effort available to write the program, the conditions under which it is to be run and the urgency with which results are required.

In determining the outline of the computer method for a major job, whether it be a technical calculation or a data processing application, it must always be remembered that the computer is going to perform many thousands of operations with no human scrutiny of any intermediate results.

The sort of situation is not uncommon where the computer finds that part of the work which is pure calculation almost trivial but where some of the decisions are hard to reduce to the settling of a clearly defined criterion. In some problems one can arrange to use the computer rather like a very powerful desk machine, with the machine doing the donkey work of the calculation and occasionally presenting the decision problem it cannot itself solve satisfactorily to the outside world. When given the answer it can carry on again until the next decision point. This approach has several

potential snags, of which the following are some:

1. It may involve a considerable waste of computer time. This is accentuated with a fast and expensive machine, as a greater proportion of the time will be taken up by the operator's thinking time.
2. It may be impossible to present all the information the operator needs for his decision without a considerable amount of otherwise unnecessary output. This also can lead to a considerable waste of time.
3. In some problems the operator cannot really help the computer a lot, as he can only gain the knowledge required for the decision by actually having the 'feel' of the problem, which he can only get from doing it. If the success of a method depends on this, it is certain that it is really unsuitable for a computer.

Apart from the main outline, computer methods often differ from those of human beings in detail. These difficulties arise from the very different proportions of arithmetical prowess, memory and visual power possessed by computers and human beings. Thus typical computers can multiply two 10-digit numbers together in much less than one thousandth of the time the human being requires even with the aid of a desk machine.

A computer's memory is much more precise than a human's, but it is limited in size, often severely so in relation to the problems it has to tackle. And if it has to pick out the largest number from a group of a hundred numbers arranged neatly in its store, it may take almost as long as the human being would to point to the largest number in a list on one side of a sheet of paper.

Thus one particular point that becomes obvious is that tables are used very sparingly as far as computers are concerned, whether they be the PAYE tables used in assessing the income tax commitments of each man on the factory payroll or the tables of square roots, sines, logarithms and so on which are indispensable to hand calculations.

More generally in a computer the obvious policy is to take advantage of the tremendous computing speed as much as possible, and to avoid methods that need very large amounts of store. There are variations in the degree to which this is applied with different computers, as one machine may have fast arithmetical facilities but a small store as compared with another. Nevertheless the differences between individual computers in this respect are of small importance compared with the difference between computers as a whole and desk machines. Thus in general there is a well-established body of so-called 'computer methods'

which contrast with the desk-machine methods of doing the same job.

The best method to adopt depends not only on the job and the machine, but on the people who are going to write the program and run it on the machine, and on the time scale for getting the results. As regards people there are three main possibilities.

1. The program will be written and operated by one person, or at least one group of people acting as one team.
2. The program will be written by one person, or group of persons, and production jobs will be run on the computer by another group, but with the original author, or authors, of the program on call if anything goes wrong.
3. The same as 2, but with the full responsibility for running the job placed on the operating team.

These three possibilities require quite different types of program. The first is the least demanding as it means in effect the programmer/operator can keep a lot of vital information in his head, or in the form of notes which only he needs to understand. He may write the program in a way such that it cannot deal with some of the less likely cases which may come up without some rearrangement of the problem, and he can rely on his own knowledge of the problem and the program to warn him when he will have to do this. This may enable him to reduce considerably the initial amount of work to be put into the program.

This technique is only acceptable if the program is needed urgently, or is likely to be used only a few times. Even then it is a poor approach if these few times are likely to be spread over a long period, as there is then a risk that the author of the program will cease to be available.

The second approach is a common one for work which is intended to become a routine job, especially so with data processing applications where the regular running time of the program may take up so much of the working week that it is impracticable to have the originating programmer present all the time. Once it is accepted though that the program will be running with the author absent, a much higher standard of programming in the first place is necessary. It is essential for there to be a complete set of operating instructions, indicating what should be done if the program detects a data inconsistency, for instance, all limitations of the program should be clearly stated and the author must ensure as far as possible that the program will do exactly as specified before he releases it for someone else to operate.

The second approach leads naturally to the third, and then the standard of programming must

be first-rate if success is to be achieved. It is usually best if a complete description of the inner workings of the program is available so that any unusual happening can be traced, and the likelihood of this must be reduced as far as possible, as tracing through another person's program is always time consuming.

3. Writing the program

There are considerable variations in the general approach to this stage. Much depends on the computer and the techniques that have been established for writing programs for it, and these in their turn depend on the general philosophy adhered to by the people who designed the machine, established programming conventions for it and wrote the first programs.

Today it is possible to look on the programmer, as he sits down to write the program for a job which is clearly defined, and where the method by which he will tackle it is agreed, as having a considerable body of established technique for programming his particular machine to guide him. His situation can be compared to that of a chess player who has not only learned the rules, but has also studied a textbook explaining the various situations he can meet in practice, and is aware of the various possible moves and counter-moves. Both chess player and computer programmer in effect rely on the techniques established for them by earlier players and programmers.

A programmer working with a well-established machine will also expect to find that some of what he needs to do has been done before, and that he can save himself a considerable amount of work by using parts of existing programs. He will then have to put together pieces of program which he has written himself with pieces which are already available.

The finished program to be produced by the programmer will consist of a list of computer instructions, probably written down one to a line in the order in which they are to be placed in the store of the computer. For his own information these instructions will usually be annotated in a fair amount of detail explaining just what the program is doing at each point.

The programmer thus finishes with a considerable amount of detailed material, but the job which he is doing was probably described originally in a few sentences. In practice there is often a bridge between these two stages, and this bridge is the so-called flow diagram.

Flow diagrams are useful in two more or less complementary ways. They can be regarded as an aid in sorting out the structure of the problem, and generally getting it into a form suitable for a computer. Alternatively their preparation can be

the penultimate process in obtaining a program written in computer language.

There are considerable differences of opinion on flow diagrams. Some regard them lightly, as an occasional aid to be used at least partly as a means of communication between programmers; sometimes the diagrams are produced after the program has been completed to serve as a record of how it works. Others look on them as an essential part of programming, and regard the real work of programming as being the production of a flow diagram, whilst the transcription of this into a computer language program is held to be a simple task, to be performed by junior staff. In these circumstances those who translate the flow diagram into computer orders are called coders, and the writing of a program becomes divided into two distinct stages, *ie.* preparing a detailed flow diagram, loosely called programming, and transcribing it, called coding.

The first approach, to use flow diagrams to only a minor extent or not at all, is more common in technical and scientific applications. The second, in which they are regarded as essential, is more often to be found in commercial data processing work.

The division is by no means clear-cut, however, as a particular approach often goes with a particular machine, and many machines are used to some extent for both categories of work. As always, there is plenty of scope for compromise. Sometimes a programmer will work from a flow diagram for part of a job, and dispense with one for the remainder; in these circumstances the flow diagram would usually be associated with the more complicated part of the job. Again, although a complete flow diagram may be produced, some parts of it may be more detailed than others.

It is clearly difficult to assess the value or necessity of flow diagrams. On the whole it is probably best to leave a fair measure of choice to the programmer doing the job, but this cannot always be allowed if a job is so big that it has to be tackled by a team.

Eventually the point is reached where a complete program exists, on paper; it may have taken anything from an hour or two to a couple of years to produce.

4. Development of the program

In spite of all the effort which has already been described as necessary for producing a complete program and putting it on to a medium which the computer can take in, the final objective of a working program is far from being reached. For it is an unfortunate fact that, however much care has been lavished upon it, the program will, with a very high degree of probability, con-

tain errors which make it quite incapable of producing the correct answers to the problem, or indeed of producing any answers at all. It would be unprofitable to try to assess all the possible reasons for this too closely, but the fact that a computer does exactly as it is told, with considerable emphasis on the 'exactly,' certainly has far-reaching consequences for programmers.

The process of development (or 'debugging') of a program consists in general of trying it out on the machine, taking note of what actually occurs and, if it is not what is supposed to happen, deducing why, putting matters right and trying again. This goes on until the program is deemed to be satisfactory.

The first requirement in testing a program is a set, or better several sets, of test data. It is important to ensure that all special cases which the program will have to deal with are tried, and also all ordinary ones, so that every instruction in the program is obeyed at least once. Otherwise it is possible to classify as working a program containing a blatant error.

However, to ensure every part of the program has been used is not really sufficient in itself. Programs are frequently defeated by combinations of circumstances rather than by single events, and it is this fact that makes it difficult ever to be 100 percent confident that a program of a fair degree of complexity will cope with all possible cases which may be presented to it.

It is not possible to give an exact classification of all types of errors which occur in programs, but the following are usually recognised, though they cannot always be looked on as clear-cut categories.

(a) *Slips.* These are often the simple replacement of one figure by another. This sort of error is of course common in all forms of figure work. In programming there are two stages at which they can occur, either when the program is written down on to the program sheet or when it is transcribed to the computer input medium.

(b) *Conceptual blunders.* These are much more serious, and are due to lack of appreciation of the problem, or some aspect of it, while the program is being written. The sort of things which could be classified under this heading would be doing a calculation by a method which did not allow the numbers being used to be represented to a sufficient degree of accuracy, or failing to allow for special cases in a problem with a complicated flow diagram.

(c) *Failures in organisation of the program.* These are rather more serious than slips, and are rather different from blunders in that they represent failings in the program itself rather than lack

CONTINUED ON PAGE 46

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'Concertina' Sets for High-speed Printing

A NEW type of multi-copy continuous stationery designed for use with high-speed printers and electric typewriters has been introduced by Lamson Paragon. Known as the Paraflex and based on similar forms used by the Moore Corporation in the USA, this system is recommended for high-speed printing, since it eliminates many of the snags hitherto encountered in tabulating carbon interleaved multi-copy sets of more than four parts, such as tenting at the folds, undue bulk on one set of

feeding sprockets due to the conventional stub, and the repacking of sets after printing.

The principle of the Paraflex system is that the carbons are not attached in a stub but cut diagonally at intervals along the binding edge. The tips of the flex-cut carbons adhere to the adjacent forms giving the 'concertina' effect at the junction of forms and carbons. In this way the thickness of forms at the left-hand margin is the same as on the right; there is a natural correction of travel between the various parts of the set and accurate registration at all speeds. Cross perforations of carbons and forms between sets allow forms to be refolded after use, decollated by hand, and broken down into various multi-part sets, each retaining its appropriate carbon. The punched edges can be removed by hand, while the sets are still in pack form.

For further details tick BO1 on page 44, or write to:—

Lamson Paragon Ltd,
Paragon Works,
Canning Town,
London, E16.

'Travel' checked



FEBRUARY 1961

Novel Random Access Memory

FURTHER details are now released of the Race memory unit, a random access storage system developed to work in conjunction with the NCR 315 computer. This unit is remarkable in that it uses Mylar plastic cards instead of magnetic drums or discs.

The cards are loaded in seconds in removable cartridges, each with a capacity of 256 cards; these cards hold between them more than five million alpha-numeric characters. Up to 16 cartridges can be attached to the computer, so that a total of 88 million characters are available at any one time. Nor is this the limit of the random access capacity since the cartridges are interchangeable, rather like tape reels, giving an unlimited filing capacity.

In each cartridge the cards are suspended from eight parallel rods. The method of selection, controlled by signals from the central processor, is based on binary principles and enables any one of the 256 cards to be released from the rods without disturbing the others. The selected card falls on a revolving drum surface and is read by multiple heads. After being read, the card is flung off the drum, goes up a chute and is returned to its cartridge.

The rate of information transfer is some 100,000 characters per second but re-access time is considerably reduced by having the cards, each carrying a considerable

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Data Processing and Control Systems Division, Kidsgrove, Stoke-on-Trent, Staffs. Telephone: Kidsgrove 2141 (11 lines)

volume of information, immediately available for re-use without sorting. Cost of a Race unit is approximately £16,000.

For further details tick BO2 on the reader enquiry coupon on page 44, or write to:—

*National Cash Register Co Ltd,
206 Marylebone Road,
London, W1.*

New Staff Location System

MANY staff location systems are currently being marketed, but Westrex claim that their new equipment, the Westrex PCS (Personal Call Service) offers a basically simpler, wholly automatic system activated by a push button, and many hitherto optional features—multi-location control, etc, are now standard. It comprises a control unit linked up to 16 or, in a large installation, up to 120 personal receivers.

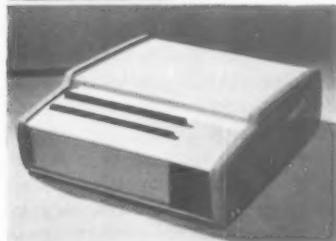
The personal receiver is carried in the executive's pocket, and signals to him by an upshining light or a discreet bleep when he is required. The system also allows for a verbal message to be transmitted following the bleep, the executive pressing a button on the receiver and holding it close to his ear to receive the message. This



(Executive bleep)

Left: The pocket receiver

Below: The central control unit



receiver is powered by dry batteries, mercury cells, or rechargeable accumulators.

Controlling the receivers is the central control unit, a small unit designed for desk operation and measuring only 11 inches by 12 inches by 3½ inches. The operator presses the selector button and the equipment automatically connects up with the appropriate receiver. Either 16-receiver or 120-receiver networks are available as standard systems, and larger installations can be specially designed. A system may also have more than one control location. The cost of a 16-receiver system is £95 for the control plus £21 per receiver. The cost of a 120-receiver system is £125 plus £21 per receiver. The hire cost works out at about 3s 6d per week per receiver?

For further details tick BO3 on the reader enquiry coupon or write to:—

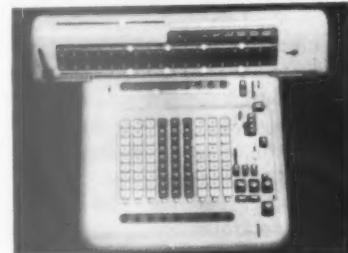
*Westrex Co Ltd,
Coles Green Road,
London, NW2.*

Combined Adding Machine and Calculator

A 'STORAGE' calculator, with a completely independent adding or subtracting register which allows a calculation result to be transferred at will and brought back at a later stage, has been developed by Archimedes-Diehl. Known as the VSR, this machine has been adopted by the United Kingdom Atomic Energy Authority, and by several science and research establishments for pre-digesting and setting figures on desk machines prior to computer operations. However, it could have a wide application in business for invoicing payroll, *pro rata* calculations, and other accounting applications where the manual moving of figures is a problem.

The VSR, with its independent register, and direct mechanical transfer between storage and product registers and the keyboard, eliminates the need for the operator to write answers on a

piece of paper and re-enter them on to a separate machine. In this way invoicing and similar operations can be calculated and totalled in a single operation by non-specialist staff, and all errors arising from manual copying avoided.



For data pre-digestion

For further details tick BO4 on the reader enquiry coupon on page 44, or write to:

*Archimedes Diehl Machine Co Ltd,
Chandos House,
Buckingham Gate,
London, SW1.*

Arithmetic Unit for Flexowriter

IN addition to the Computyper (mentioned in the data processing survey of January, 1961) Fridens have now brought out a sterling arithmetic unit for use with their Flexowriter Programmatic card/tape-operated typewriter systems. This unit is available in sterling and decimal, and so is fully compatible with British usage, enabling the Flexowriter to add, subtract, and accumulate totals and sub-totals.

The arithmetic unit is linked to the Flexowriter via the connectors built into the typewriter for a second reader and punch; thus no special adaptation is needed. It can be a free-standing cabinet or be built into the Flexowriter desk.

In addition to the control unit, which is controlled electronically by instructions punched into program tape or edge-punched cards, there are up to four accumulators, which can be addressed separately and instructed to add, subtract, read out totals or sub-totals and re-set. The accumulators may consist of any number of digits, and

each has an overload indicator to signal when its capacity is exceeded. The unit can be specially designed to have more than four accumulators, subject to investigation.

Optional features include a 10-key keyboard which allows amounts to be manually entered while the Flexowriter is performing another automatic operation, the operator checking on a visual display that the amount is correct, and pressing a key to allow the Flexowriter to call out the amount, to print it automatically and to add or subtract it in the accumulator, under control of the program tape. Other optional facilities: a transfer facility for accumulating grand total and obtaining a balance between accumulation; a credit balance feature; and a date and consecutive number emitter, to allow the date and invoice number to be printed automatically on each form in the desired position.

Bulmers, who market the unit, say the cost is a minimum of £1,200 and delivery time seven months.

For further information tick B05 on the reader enquiry coupon below or write to:

*Bulmers (Calculators) Ltd.
Empire House,
45-47 Worship Street,
London, EC1.*

New Teleprinter Form Feed

FANFOLD Ltd announce a new stationery feed equipment, the Carbaline, for use with Creed 75 Teleprinters. The Carbaline feed incorporates an automatic compensating control unit for selecting single, double or treble line spacing as required. In addition this heading throw facility automatically moves the printing head directly from the last line of one form to the first line of the next, eliminating the need for space symbols in the tape.

The Carbaline feed works on the continuous carbon roll principle, by which the carbon is interleaved between the forms continuously, and moved along fractionally at every line printing. In this way a better grade of carbon can be utilised.

The registration of the forms is maintained by adjustable aligners, which engage in six sprocket holds on the paper, and which can be swung outwards to facilitate loading. The continuous stationery is housed in a built-in carriage in the rear of the teleprinter and loaded on the machine via the angled guide platen. The makers say that considerable economy of teleprinter stationery is made possible by this system.



Speedy feeder

For further information tick B06 on the reader enquiry coupon below, or write to:—
*Fanfold Ltd.
Bridport Road,
London, N18.*

Largest Drum Memory Store

UP to 24 million digits can be stored in the Univac Randex storage system—the equivalent, say the makers Remington Rand, of a stack of cards nine storeys high. This substantial capacity involves only two storage drums—and the system is capable of expansion to 10 drums; thus it would seem that the system offers the largest capacity of any storage method.

The Randex storage system operates on the line with Univac solid-state and Step computers. It uses a method of co-ordinated data processing, allowing searching, reading, punching and printing to be carried out simultaneously. The capacity and co-ordinating facility of the system means that inventory updating, sales analysis, billing, etc., are possible at greater speeds, involving millions of items. The information filed on the drum is retrieved in thousandths of a second, fed directly to the computer, updated and returned. A built-in checking circuit allows data to be checked automatically on transfer.

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gram; *i.e.* when the re-order point is reached the purchase orders relating to the item are automatically printed.

The makers claim that the cost of the equipment—no sterling price has been specified—is made economical by the greater volume of storage and the increased speed of processing which it gives to the computer operation.

For further information tick BO7 on the reader enquiry coupon on page 44, or write to:—

*Remington Rand Ltd.,
Remington House,
61-65 High Holborn,
London, EC1.*

Tape Input for Adding Machine

MONROE CALCULATORS are negotiating with their parent company in the United States to introduce in this country the Synchro-Monroe adding machine, which has just begun to be marketed there.

This system allows accountants to prepare client accounts in punched tape, thereby providing a means of direct input into computer or other data processing system. The machine enables a program tape to be prepared through the accounting keyboard, and facilities are built in to allow coded information to be repeated automatically. In this way repetitive re-indexing of reference numbers, etc, is avoided.

The existing Synchro-Monroes operative in the USA are decimal machines, and the British company expect that there may be a little time lapse before the sterling machine is produced. However, they anticipate that by the end of the year most of the adaptation troubles will be overcome.

For further details tick BO8 on the reader enquiry coupon on page 44, or write to:—

*Monroe Calculating Machine Co. Ltd.,
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Aldwych,
London, WC2.*

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The Programmer's Task

CONTINUED FROM PAGE 38

of appreciation of the job being tackled. Thus one might try to use the same location in the store for two different purposes at the same time.

(d) *Operating errors.* These are not strictly programming errors at all, but often lead to similar consequences. They occur when the operator fails to carry out a predetermined procedure when actually using the machine and, for example, puts paper tapes or packs of punched cards through in the wrong order.

To sum up on programming errors in general, it is true to say that their detection and rectification plays a very big part in a programmer's life.

5. The initial production runs of a program

When the programmer is reasonably satisfied that his program works to the specification laid down for it, the question of actually beginning to do real work comes up. With certain types of work, especially the smaller technical calculations, the point between finishing off testing the program and starting to do production work may be difficult to determine. In effect the programmer may have been told, 'Here is a problem, with the data (or sets of data) for which particular results are

required. Write a program and then produce the results.'

In these circumstances, providing the problem is not too complicated, the programmer will probably look on all this as one job, and to some extent will use the data of the real problems he has to solve as his test cases. He is in an especially strong position to do this if the solutions he has to provide can be easily checked once they have been found.

Although there are a fair number of jobs of the one-off type done on computers, a much more important category is that type of work where some existing data processing system is to be taken over by a computer system. This of course usually means commercial data processing, such as payrolls and production control systems. Here there is a very serious problem in the initial production runs, as it is at this point that the computer system first begins to interfere with the existing system. Thus as long as a programmer is writing and developing his payroll program, the existing arrangements for calculating each man's wages go on as before, but when the computer is alleged to be ready to take over the job, it would be inviting disaster to scrap the existing system entirely at one stroke.

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Bookings for these courses may be made either through Heads of Sales Teams etc., or direct to Computer Education Centre, 88 Baker Street, London, W.I. Tel. WELbeck 4464 Ext. 105

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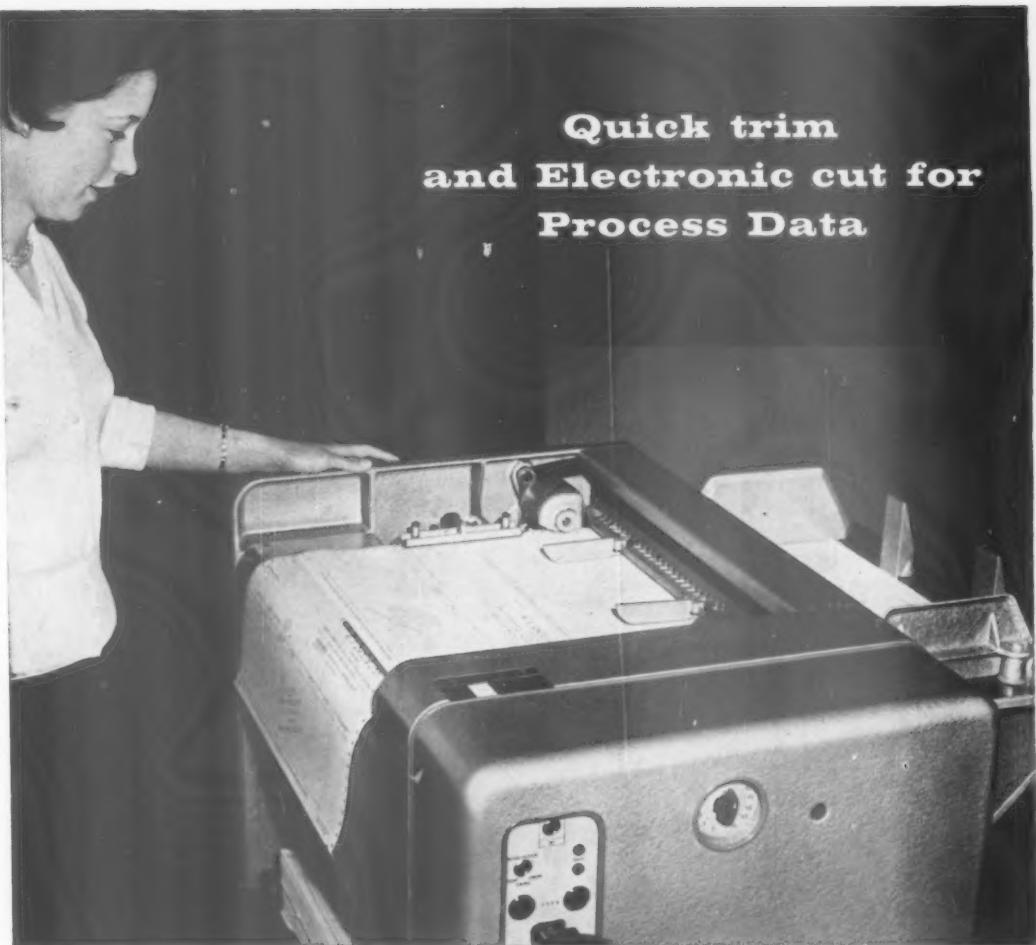
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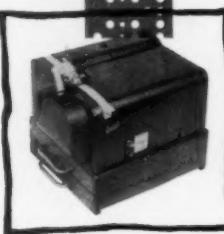
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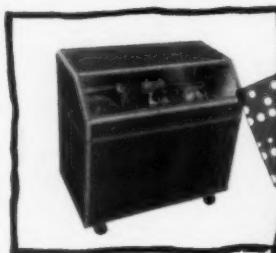
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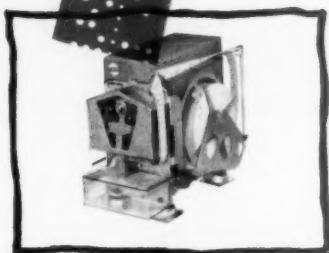
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